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Insight Report

The Global Risks Report 2016
11th Edition

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The report and an interactive data platform are available at http://wef.ch/risks2016

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Figure 1: The Global Risks Landscape 2016

Top 10 risks in terms of
Likelihood

1. Large-scale involuntary migration
2. Extreme weather events
3. Failure of climate-change mitigation and adaptation
4. Interstate conflict
5. Natural catastrophes
6. Failure of national governance
7. Unemployment or underemployment
8. Data fraud or theft
9. Water crises
10. Illicit trade

Top 10 risks in terms of
Impact

1. Failure of climate-change mitigation and adaptation
2. Weapons of mass destruction
3. Water crises
4. Large-scale involuntary migration
5. Energy price shock
6. Biodiversity loss and ecosystem collapse
7. Fiscal crises
8. Spread of infectious diseases
9. Asset bubble
10. Profound social instability

Categories

- Economic
- Environmental
- Geopolitical
- Societal
- Technological

Source: Global Risks Perception Survey 2015.
Note: Survey respondents were asked to assess the likelihood and impact of the individual risks on a scale of 1 to 7, 1 representing a risk that is not likely to happen or have impact, and 7 a risk that is very likely to occur and have massive and devastating impacts. See Appendix B for more details. To ensure legibility, the names of the global risks are abbreviated; see Appendix A for the full name and description.

Figure 2: The Global Risks Interconnections Map 2016

Source: Global Risks Perception Survey 2015.
Note: Survey respondents were asked to identify between three and six pairs of global risks they believe to be most interconnected. See Appendix B for more details. To ensure legibility, the names of the global risks are abbreviated; see Appendix A for the full name and description.

Table A: Global Risks 2016

- Asset bubble in a major economy
- Deflation in a major economy
- Failure of a major financial mechanism or institution
- Failure/shortfall of critical infrastructure
- Fiscal crises in key economies
- High structural unemployment or underemployment
- Illicit trade (e.g. illicit financial flow, tax evasion, human trafficking, organized crime, etc.)
- Severe energy price shock (increase or decrease)
- Unmanageable inflation
- Extreme weather events (e.g. floods, storms, etc.)
- Failure of climate-change mitigation and adaptation
- Major biodiversity loss and ecosystem collapse (land or ocean)
- Major natural catastrophes (e.g. earthquake, tsunami, volcanic eruption, geomagnetic storms)
- Man-made environmental catastrophes (e.g. oil spill, radioactive contamination, etc.)
- Failure of national governance (e.g. failure of rule of law, corruption, political deadlock, etc.)
- Interstate conflict with regional consequences
- Large-scale terrorist attacks
- State collapse or crisis (e.g. civil conflict, military coup, failed states, etc.)
- Weapons of mass destruction
- Failure of urban planning
- Food crises
- Large-scale involuntary migration
- Profound social instability
- Rapid and massive spread of infectious diseases
- Water crises
- Adverse consequences of technological advances
- Breakdown of critical information infrastructure and networks
- Large-scale cyberattacks
- Massive incident of data fraud/theft

Table B: Trends 2015

- Ageing population
- Changing landscape of international governance
- Climate change
- Environmental degradation
- Growing middle class in emerging economies
- Increasing national sentiment
- Increasing polarization of societies
- Rise of chronic diseases
- Rise of cyber dependency
- Rising geographic mobility
- Rising income and wealth disparity
- Shifts in power
- Urbanization

Figure 3: The Most Likely Global Risks 2016: A Regional Perspective

Source: Global Risks Perception Survey 2015.
Note: Respondents were asked to select the three global risks that they believe are the most likely to occur in their region. For legibility reasons, the names of the global risks are abbreviated; see Appendix A for the full name and description. Oceania is not displayed because of the low number of respondents.

Figure 4: The Risks-Trends Interconnections Map 2016

Source: Global Risks Perception Survey 2015.
Note: Survey respondents were asked to select the three trends that are the most important in shaping global development in the next 10 years. For each of the three trends identified, respondents were asked to select the risks that are most strongly driven by those trends. See Appendix B for more details. To ensure legibility, the names of the global risks are abbreviated; see Appendix A for the full name and description.

The Global Risks Report 2016
11th Edition

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Contents

4 **Preface**
By Klaus Schwab

6 **Executive Summary**

8 **Introduction**

10 **Part 1: Global Risks 2016**

- 11 Box 1.1: Methodology of *The Global Risks Report*
- 14 Box 1.2: The Paris Agreement: A Historic Turning Point on Climate Change
- 16 Box 1.3: Refugees in Malaysia
- 17 Box 1.4: China's Financial Vulnerabilities and the Transition to the New Normal
- 19 Box 1.5: Pathways to Resilience: Effective Leadership and Institutional Values

24 **Part 2: The Security Outlook 2030**

- 24 Box 2.1: International Security Defined
- 25 Box 2.2: A Deep-Dive into International Security
- 27 Box 2.3: Public-Private Collaboration in Complex Crises
- 29 Box 2.4: The Seven Driving Forces of International Security
- 30 Box 2.5: Scenarios Methodology

38 **Part 3: Risks in Focus**

- 39 3.1 (Dis)Empowered Citizen
  - 40 Box 3.1.1: The (Dis)Empowered Citizen: A Definition
  - 42 Box 3.1.2: Digital Government Technologies: The (Persisting) Challenges of Inclusiveness and Engagement
- 50 3.2 Climate Change and Risks to Food Security
  - 52 Box 3.2.1: Adaptation and Its Limits
  - 53 Box 3.2.2: Reducing Food Waste
- 59 3.3 Global Disease Outbreaks
  - 61 Box 3.3.1: Health Communication
  - 62 Box 3.3.2: Developing an Ebola Vaccine: Reflections on the Current Regulatory Environment
  - 63 Box 3.3.3: The Pandemic Emergency Financing Facility (PEF)

68 **Part 4: Risks for Doing Business at a Glance**

- 69 Box 4.1: The World Economic Forum's Executive Opinion Survey

82 **Conclusions**

84 **Appendices**

- 85 Appendix A: Description of Global Risks and Trends 2016
- 88 Appendix B: Global Risks Perception Survey and Methodology 2015
- 90 Appendix C: The Executive and Opinion Survey 2015: Views of the Business Community on the Global Risks of Highest Concern for Doing Business

92 **Acknowledgements**

Preface

This 11th edition of *The Global Risks Report* is published at a time of profound change. Global risks materialize in new and unexpected ways and are becoming more imminent as their consequences reach people, institutions and economies. We witness the effects of climate change in the rising frequency and intensity of water shortages, floods and storms worldwide. Stable societies are becoming increasingly fragmented in many regions of the world, and we note a weak global economy that is again facing headwinds.

At the same time, advances in technology and rapid digitization are fundamentally transforming societies, economies and ways of doing business. Often referred to as the Fourth Industrial Revolution, this development presents great opportunities for all actors involved and a previously unimagined solution space for some of the world's most pressing problems. Yet it also presents elusive risks related to changing employment patterns, widening income inequality and rising cyber dependence. Managing the paradigm shift and transition process will be critical to securing stable economies and ultimately thriving societies. Achieving this calls for greater resilience as the key imperative for action. Collaboration across countries, areas of expertise and stakeholder groups is necessary to effectively address global risks and deliver on the resilience imperative. Yet across every sector of society, decision-makers are struggling to find common ground as they are faced with heightened volatility, uncertainty, interconnectedness and pace of change.

The motivations underlying *The Global Risks Report* at its inception in 2006 – to shed light on global risks and developments and help create a shared understanding of the most pressing issues confronting the world, the ways they interconnect and their potential negative impacts – are therefore more relevant than ever. A shared understanding of challenges is needed as a base for multistakeholder collaboration, which has seen increasing recognition as the most effective way to address global risks and build resilience against them. To further inspire action, this year's *Report*, like last year's, also contributes to a shared understanding of the solution space, presenting examples of risk mitigation and resilience practices in the Risks in Focus section. In addition this year's *Global Risk Report* includes a chapter dedicated to better understanding the evolving international security landscape and improving outcomes.

As in previous years, the *Report* is based on the annual Global Risks Perception Survey, completed by almost 750 members of the World Economic Forum's global multistakeholder community. In addition to the special section exploring the evolving security landscape in an era of uncertainty, the *Report* presents deep-dive discussions of risks to the stability of societies posed by the (dis)empowered citizen, who is empowered by technology but feels disempowered by traditional decision-making processes. It also discusses the societal consequences of climate change with a focus on food and water crises and the threat of global pandemics.

As one of the Forum's flagship reports, *The Global Risks Report* has been a collaborative effort since its first edition in 2006. Produced by the Forum, it is able to draw on the unique expertise available within the Forum's different communities and knowledge networks as well as within the organization as a whole. It also builds firmly on the Forum's ongoing research, projects, debates and initiatives. The insights presented here are the result of numerous discussions, consultations and workshops and reflect the views of leaders from our various communities through the Global Risks Perception Survey.

With this in mind, I would like to thank our Strategic Partners, Marsh & McLennan Companies and the Zurich Insurance Group, represented on the Steering Board by John Drzik, President, Global Risk and Specialties, Marsh & McLennan; and Cecilia Reyes, Group Chief Risk Officer, Zurich Insurance Group. Furthermore, I am grateful to our academic advisers the National University of Singapore, the Oxford Martin School at the University of Oxford and the Wharton Risk Management and Decision Processes Center at the University of Pennsylvania.

The *Report* has also greatly benefited from the dedication and valuable guidance of the members of the Global Risks 2016 Advisory Board. Members are Rolf Alter, Organisation for Economic Co-operation and Development (OECD); Mario Blejer, Banco Hipotecario SA; Winnie Byanyima, Oxfam International; Marie-Valentine Florin, International Risk Governance Council (IRGC); Steven Kou, National University of Singapore; Julian Laird, Oxford Martin School; Pascal Lamy, Notre Europe - Jacques Delors Institute; Ursula von der Leyen, Federal Minister of Defence of Germany; Maleeha Lodhi Ambassador and Permanent Representative of Pakistan to the United Nations; Erwann Michel-Kerjan, The Wharton School, University of Pennsylvania; Nicolas Mueller, Federal Chancellery of Switzerland; Moisés Naím, Carnegie Endowment for International Peace; Jonathan Ostry, International Monetary Fund; Manuel Pulgar-Vidal Otalora, Minister of Environment of Peru; Nouriel Roubini, New York University; Anders Sandberg, University of Oxford; Richard Smith-Bingham, Marsh & McLennan Companies; Michelle Tuveson, Centre for Risk Studies, University of Cambridge; Steve Wilson, Zurich Insurance Group; and Sandra Wu Wen-Hsiu, Japan Asia Group Limited.

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I would also like to thank Richard Samans, Managing Director; Jennifer Blanke, Chief Economist; and Margareta Drzeniek Hanouz, Head of Global Competitiveness and Risks for their leadership on this effort as well as *The Global Risks Report 2016* project team members Ciara Browne, Attilio Di Battista, Caroline Galvan, Gaëlle Marti, and Stephanie Vérin for their contributions.

Last but not least, this *Report* would not have been possible without the time and commitment of the respondents who completed the Global Risks Perception Survey and the participants in the Changing International Security Landscapes project.

Klaus Schwab
Founder and Executive Chairman
World Economic Forum

Executive Summary

Now in its 11th edition, *The Global Risks Report 2016* draws attention to ways that global risks could evolve and interact in the next decade. The year 2016 marks a forceful departure from past findings, as the risks about which the *Report* has been warning over the past decade are starting to manifest themselves in new, sometimes unexpected ways and harm people, institutions and economies. Warming climate is likely to raise this year's temperature to 1° Celsius above the pre-industrial era, 60 million people, equivalent to the world's 24th largest country and largest number in recent history, are forcibly displaced, and crimes in cyberspace cost the global economy an estimated US$445 billion,[1] higher than many economies' national incomes. In this context, the *Report* calls for action to build resilience – the "resilience imperative" – and identifies practical examples of how it could be done.

Box 1: Definition of Global Risks and Trends

A **global risk** is *an uncertain event or condition that, if it occurs, can cause significant negative impact for several countries or industries within the next 10 years.*
A **global trend** is *a long-term pattern that is currently taking place and that could contribute to amplifying global risks and/or altering the relationship between them.*

Geopolitical concerns remain prominent in the minds of respondents to the Global Risks Perception Survey for the second year in a row. The *Report* therefore delves into the international security landscape and explores what drives this evolution and, in particular, how it could be affected by the Fourth Industrial Revolution and climate change. The three scenarios for possible futures developed in this context inform new ways of building resilience to security threats through public-private collaboration.

The *Report* also steps back and explores how emerging global risks and major trends (see Box 1), such as climate change, the rise of cyber dependence and income and wealth disparity are impacting already-strained societies by highlighting three clusters of risks as Risks in Focus. As resilience building is helped by the ability to analyse global risks from the perspective of specific stakeholders, the *Report* also analyses the significance of global risks to the business community at a regional and country-level.

The Global Risks Perception Survey

Almost 750 experts and decision-makers in the World Economic Forum's multistakeholder communities responded to this year's Global Risks Perception Survey. Respondents are drawn from business, academia, civil society and the public sector and span different areas of expertise, geographies and age groups.

The survey asked respondents to consider 29 global risks – categorized as societal, technological, economic, environmental or geopolitical – over a 10-year time horizon, and rate each according to their perceived likelihood of it occurring and impact if it does.

After its presence in the top five most impactful risks for the past three years, the **failure of climate change mitigation and adaptation** has risen to the top and is perceived in 2016 as the most impactful risk for the years to come, ahead of **weapons of mass destruction**, ranking 2nd, and **water crises**, ranking 3rd. Large-scale involuntary migration was also rated among the top five for impact, as was **severe energy price shock (increase or decrease).**

The risk rated most likely was **large-scale involuntary migration**, with last year's top scorer – **interstate conflict with regional consequences** – giving way to the environmental risks of **extreme weather events** and the **failure of climate change mitigation and adaptation** and followed by **major natural catastrophes**.

Global risks that remain serious because of their combined impact and likelihood involve some economic risks, including **fiscal crises in key economies** and **high structural unemployment and underemployment.** These are complemented by **cyberattacks** and **profound social instability.** Their assessment reflects the potentially profound impact of the Fourth Industrial Revolution on the economy and society and emphasizes the need for safeguarding future benefits.

Respondents were also asked which risks were related and could give rise to cascading risks. Three emerged strongly: the potential for **climate change to exacerbate water crises,** with impacts including conflicts and more forced migration, calling for improved water governance to adapt to climate change and accommodate a growing population and economic development; the need to **address the global refugee crisis,** adding emphasis to policies that can build resilience in addition to responding to the immediate crisis; and the risks of failing to fully understand the risks around the Fourth Industrial Revolution and how this transition will impact countries, economies and people at a time of persistently sluggish growth.

Risks in Focus

Key to building resilience is the stability of societies. The first Risk in Focus therefore looks at the complex dynamics of societies in the age of digitization and discusses the phenomenon of the **(dis)empowered citizen,** which is a result of the interplay of varying dynamics: as technology empowers citizens to find information, connect with others and organize, those citizens feel disenfranchised by distant elites. It explores the risk of social instability if both governments and business embark on either repressive actions or non-action out of uncertainty about how to deal with a more informed, connected and demanding citizenry, which could lead to an escalating downward spiral of broken trust and harsher response on either side. The chapter also, however, explores the benefits governments and business stand to gain by proactively looking for ways to engage with concerned citizens.

Food security risk in the context of climate change is the second Risk in Focus. Building upon the climate-water nexus discussed in Part 1, the chapter looks at how changing climate and weather patterns could jeopardize food security and agricultural production across geographies. The most climate-vulnerable countries often heavily depend on agricultural productivity to sustain economic growth and development. But the recent years have also shown the climate vulnerability of G-20 countries such as India, Russia and the United States – the breadbasket of the world – and other large industrial producers of agricultural commodities. The chapter discusses how climate change–resilient crops and supply chain networks, as well as financing and insurance schemes, can help mitigate the social, economic and environmental aspects of food security risks related to climate change.

Drawing lessons from the Ebola crisis, the third Risk in Focus discusses **global disease outbreaks.** It warns that population growth, rapid urbanization and increasing transnational flows of commodities, people and animals intensify the risk of infectious transmission across geographies while equally diminishing the ability to respond – all at a time of growing resistance of microorganisms to today's most effective medicines. Preparedness and response measures range from the behavioural, such as fact-based communication and education campaigns, to the need to invest in diagnostic, drug and vaccine R&D and in its enabling environment, especially advancing a regulatory framework. It raises the imperative for public-private sector collaboration across areas such as data availability and analysis, a joint research agenda, regulatory frameworks, long-term financing and ways to promote responsible media engagement as part of effective crisis management communication.

For each Risk in Focus, examples are given of three practical mechanisms that can build resilience against the identified threats.

Risks to Doing Business

Private sector respondents to the World Economic Forum's Executive Opinion Survey were asked to identify their risks of highest concern for doing business in the next 10 years. The responses, from 140 economies, reveal patterns of concern at country and regional levels that can usefully inform initiatives to engage the private sector in building resilience to global risks.

On a global scale, two economic risks – **unemployment and underemployment** and **energy price shocks** – are mentioned as the top risks of highest concern for doing business in half of the 140 economies. These are followed by the failure of national governance, fiscal crises, asset bubbles and cyberattacks.

Economic risks predominate in responses from **Europe,** including fiscal crises, unemployment, asset bubbles and energy prices – the latter also being the top concern in **Canada** – while executives in the **United States** are most concerned about cyber-related risks and attacks. Respondents from **Central Asia and Russia** worry about fiscal crises and unemployment, along with the risks of unmanageable inflation and interstate conflict. Environmental risks worry business leaders in **East Asia and the Pacific,** alongside energy prices, asset bubbles, and cyber attacks.

In **South Asia** concerns also include energy prices, together with fiscal crises, unemployment and failure of national governance – which is the top concern in **Latin America and the Caribbean** – followed by energy prices shock and unemployment. Executives in the **Middle East and North Africa** likewise worry about energy prices, together with unemployment, terrorist attacks and interstate conflict. In **Sub-Saharan Africa,** the business community's top concerns include unemployment, energy prices, the failure of national governance and the failure of critical infrastructure.

Introduction

Over the past decade, *The Global Risks Report* has expanded its scope from analysing the interconnected and rapidly evolving nature of global risks to also putting forward actionable solutions and calling for public-private collaboration in strengthening resilience. Now in its 11th edition, the *Report* describes a world in which risks are becoming more imminent and have wide-ranging impact: tensions between countries affect businesses; unresolved, protracted crises have resulted in the largest number of refugees globally since World War II; terrorist attacks take an increasing toll on human lives and stifle economies; droughts occur in California and floods in South Asia; and rapid advances in technologies are coupled with ever-growing cyber fragilities and persistent unemployment and underemployment.

Implications of sweeping digitization (also termed the "Fourth Industrial Revolution"), ranging from transformations that are the result of rising cyber connectivity to the potential effects of innovations on socio-economic equality and global security, remain far from fully understood. At the same time, climate change is unequivocally happening, and there is no turning back time.

The increasing volatility, complexity and ambiguity of the world not only heightens uncertainty around the "which", "when", "where" and "who" of addressing global risks, but also clouds the solutions space. We need clear thinking about new levers that will enable a wide range of stakeholders to jointly address global risks, which cannot be dealt with in a centralized way.

Taken together, this calls for a *resilience imperative* – an urgent necessity to find new avenues and more opportunities to mitigate, adapt to and build resilience against global risks and threats through collaboration among different stakeholders.

By putting the resilience imperative at its core, this year's *Global Risks Report* combines four parts to present an analysis of different aspects of global risks – across both global risks and stakeholders – focused as much on the search for solutions as on the analysis of the risks themselves.

Part 1 analyses the difference in risk perceptions over different time horizons and the perceived interconnections among risks, as visualized in the Global Risks Landscape 2016, all based on the Global Risks Perception Survey, which combines the views of different stakeholders. Three risk interconnection clusters stand out: climate change in relation to water and food crises; the growing challenges of the rising number of displaced people worldwide; and what the Fourth Industrial Revolution means in an era of economic risks.

Part 2 discusses the implications of a changing international security landscape and identifies the drivers that are at work and the implications for **addressing global risks.** Inspired by the results of *The Global Risks Report 2015* and the continued instability of the global security situation, it lays out alternative and plausible futures that could materialize unless there is a change in how we respond and manage the forces at play.

Part 3 explores three risks clusters that have the potential to challenge social stability. For each of these "Risks in Focus", it describes three existing, practical initiatives that could help to build resilience. The concept of the **(dis)empowered citizen** is introduced to describe the tensions created by growing cyber connectivity that empowers citizens at the same time as they feel increasingly disenfranchised from traditional decision-making processes. The second contribution further explores one impact of **climate change**: coupled with rising population growth, it is threatening **food security.** Finally, in the wake of the Ebola crisis, the potential of **pandemics** to threaten social cohesion is discussed.

Part 4 applies the resilience imperative to one specific stakeholder – the business community – with an analysis at country and regional levels. Drawing on a unique data set of more than 13,000 business leaders in 140 economies, it explores the differing landscape of global risks across regions and offers a deep-dive into five of the six most cited global risks worldwide. Its aim is to inform the discussion of which risks to prioritize in order to build resilience within businesses.

- Asset bubble in a major economy
- Deflation in a major economy
- Failure of a major financial mechanism or institution
- Failure/shortfall of critical infrastructure
- Fiscal crises in key economies
- High structural unemployment or underemployment
- Illicit trade (e.g. illicit financial flow, tax evasion, human trafficking, organized crime, etc.)
- Severe energy price shock (increase or decrease)
- Unmanageable inflation
- Extreme weather events (e.g. floods, storms, etc.)
- Failure of climate-change mitigation and adaptation
- Major biodiversity loss and ecosystem collapse (land or ocean)
- Major natural catastrophes (e.g. earthquake, tsunami, volcanic eruption, geomagnetic storms)
- Man-made environmental catastrophes (e.g. oil spill, radioactive contamination, etc.)
- Failure of national governance (e.g. failure of rule of law, corruption, political deadlock, etc.)
- Interstate conflict with regional consequences
- Large-scale terrorist attacks
- State collapse or crisis (e.g. civil conflict, military coup, failed states, etc.)
- Weapons of mass destruction
- Failure of urban planning
- Food crises
- Large-scale involuntary migration
- Profound social instability
- Rapid and massive spread of infectious diseases
- Water crises
- Adverse consequences of technological advances
- Breakdown of critical information infrastructure and networks
- Large-scale cyberattacks
- Massive incident of data fraud/theft

Part 1: Global Risks 2016

From the refugee crisis to economic slowdowns in emerging markets, from ever-rising numbers of terrorist and cyberattacks to water shortages, global risks have been in the headlines in the last year. Yet so have initiatives to address them, such as the COP21 meeting on reducing greenhouse gas emissions or European Union (EU) summits to address the refugee crisis.[1] The *Global Risks Report* exists to raise awareness about global risks and their potential interconnections, and to provide a platform for discussion and action to mitigate, adapt and strengthen resilience.

There is remarkable stability in this year's Global Risks Landscape (Box 1.1): many risks that are assessed as above average in terms of likelihood and impact were similarly assessed last year. This suggests the emergence of a new status quo, with geopolitical risks – such as **interstate conflict** or **terrorist attacks**[2] – being at the forefront. Other risks rated as highly impactful or likely, such as involuntary migration and social instability, are partly a result of spillover effects of insecurity and conflict. Some geopolitical risks – such as the failure of national governance, which is pervasive across Latin America and Sub-Saharan Africa (see Figure 3) and considered to be among the top three most likely risks in the Middle East and North Africa, East Asia and the Pacific, and Central Asia – are considered to be important in some regions but not globally impactful. Consistent with the past, weapons of mass destruction is ranked as the second least likely risk to occur, but the second most impactful if it were to. Part 2 of this *Report* explores the international security landscape and how it could evolve in future.

Also prominent in the Global Risks Landscape 2016 are environmental risks such as **failure of climate-change mitigation and adaptation,** which is considered the most potentially impactful risk and the third most likely, with **water crises,**[3] **biodiversity loss and ecosystem collapse** rising up the list of concerns. Environmental worries have been at the forefront in recent years (Figure 1.1.1), reflecting a sense that climate change–related risks have moved from hypothetical to certain because

Box 1.1: Methodology of *The Global Risks Report*

This *Report* defines a "global risk" as *an uncertain event or condition that, if it occurs, can cause significant negative impact for several countries or industries within the next 10 years*. Based on this refined definition, this year 29 global risks were identified and grouped into the five customary categories: economic, environmental, geopolitical, societal and technological. A description of the risks and the methodology employed can be found in Appendices A and B.

The *Report* also identifies 13 global trends that can potentially drive global risks. A "trend" is defined as *a long-term pattern that is currently taking place and that could contribute to amplifying global risks and/or altering the relationship between them*. Unlike risks, trends are occurring with certainty and can have both positive and negative consequences. Trends can alter how risks evolve and interrelate, and they inform efforts at risk mitigation.

Figure 1.1.1: The Evolving Risks Landscape, 2007–2016

Top 5 Global Risks in Terms of Likelihood

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
1st	Breakdown of critical information infrastructure	Asset price collapse	Asset price collapse	Asset price collapse	Storms and cyclones	Severe income disparity	Severe income disparity	Income disparity	Interstate conflict with regional consequences	Large-scale involuntary migration
2nd	Chronic disease in developed countries	Middle East instability	Slowing Chinese economy (<6%)	Slowing Chinese economy (<6%)	Flooding	Chronic fiscal imbalances	Chronic fiscal imbalances	Extreme weather events	Extreme weather events	Extreme weather events
3rd	Oil price shock	Failed and failing states	Chronic disease	Chronic disease	Corruption	Rising greenhouse gas emissions	Rising greenhouse gas emissions	Unemployment and underemployment	Failure of national governance	Failure of climate-change mitigation and adaptation
4th	China economic hard landing	Oil and gas price spike	Global governance gaps	Fiscal crises	Biodiversity loss	Cyber attacks	Water supply crises	Climate change	State collapse or crisis	Interstate conflict with regional consequences
5th	Asset price collapse	Chronic disease, developed world	Retrenchment from globalization (emerging)	Global governance gaps	Climate change	Water supply crises	Mismanagement of population ageing	Cyber attacks	High structural unemployment or underemployment	Major natural catastrophes

Top 5 Global Risks in Terms of Impact

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
1st	Asset price collapse	Asset price collapse	Asset price collapse	Asset price collapse	Fiscal crises	Major systemic financial failure	Major systemic financial failure	Fiscal crises	Water crises	Failure of climate-change mitigation and adaptation
2nd	Retrenchment from globalization	Retrenchment from globalization (developed)	Retrenchment from globalization (developed)	Retrenchment from globalization (developed)	Climate change	Water supply crises	Water supply crises	Climate change	Rapid and massive spread of infectious diseases	Weapons of mass destruction
3rd	Interstate and civil wars	Slowing Chinese economy (<6%)	Oil and gas price spike	Oil price spikes	Geopolitical conflict	Food shortage crises	Chronic fiscal imbalances	Water crises	Weapons of mass destruction	Water crises
4th	Pandemics	Oil and gas price spike	Chronic disease	Chronic disease	Asset price collapse	Chronic fiscal imbalances	Diffusion of weapons of mass destruction	Unemployment and underemployment	Interstate conflict with regional consequences	Large-scale involuntary migration
5th	Oil price shock	Pandemics	Fiscal crises	Fiscal crises	Extreme energy price volatility	Extreme volatility in energy and agriculture prices	Failure of climate-change mitigation and adaptation	Critical information infrastructure breakdown	Failure of climate-change mitigation and adaptation	Severe energy price shock

Economic | Environmental | Geopolitical | Societal | Technological

Source: World Economic Forum 2007–2016, *Global Risks Reports*.

Note: Global risks may not be strictly comparable across years, as definitions and the set of global risks have evolved with new issues emerging on the 10-year horizon. For example, cyberattacks, income disparity and unemployment entered the set of global risks in 2012. Some global risks were reclassified: water crises and rising income disparity were re-categorized first as societal risks and then as a trend in the 2015 and 2016 Global Risks Reports, respectively. The 2006 edition of the Global Risks Report did not have a risks landscape.

As in previous years, assessments of risks in this year's *Report* are based on the Global Risks Perception Survey. The survey captures the perceptions of almost 750 experts and decision-makers in the World Economic Forum's multistakeholder communities and was conducted in Fall 2015. Respondents are drawn from business, academia, civil society and the public sector and span different areas of expertise, geographies and age groups.

The analysis takes into account three complementary angles on global risks: an assessment of their likelihood and impact (Figure 1), and how these have evolved over the years (Figure 1.1.1); a regional breakdown of the perceived likelihood of risks (Figure 3); a mapping of interconnections among risks (Figure 2) and among risks and trends (Figure 4); and the difference of the level of concern in the short and long term (Figure 1.2).

insufficient action has been undertaken to address them.

Figure 1.1 shows risks that have registered the highest increases and declines in perceptions of likelihood and impact, notably **large-scale involuntary migration,** now rated as the most likely and fourth most impactful. Other risks gaining in prominence on both dimensions include **profound social instability** – also one of the most highly interconnected risks, as shown in Figure 2.

The economic risks of **unemployment and underemployment, asset bubbles,** and **fiscal crises in key economies** have increased in both likelihood and impact over the past two years, although these have been overtaken by other concerns. At the same time, cyber threats remain at the top of respondents' minds, as in previous years.

To tease apart short- and longer-term thinking and shed light on the psychology behind the responses, the survey asked experts to nominate risks of highest concern over two time horizons: 18 months and 10 years. Global risks that have recently been in the headlines – such as large-scale involuntary migration, interstate conflict and cyberattacks – tend to feature higher as short-term concerns, indicating that recent events significantly influence our thinking about risks and, hence, stakeholder action.

The longer-term concerns are more related to underlying physical and societal trends, such as the failure of climate change mitigation and adaptation, water crises and food crises. Interestingly, extreme weather events and social instability are considered a concern in both the short and long term, reflecting an expectation that the frequency and intensity of crises will continue to rise. One of the roles of this *Report* is to raise awareness about the importance of long-term thinking about global risks – especially significant when it comes to attempting to limit the extent of climate change and to adapt to the change that is already inevitable.

Three risk clusters are discussed in more detail below: the cluster linking the failure of climate change mitigation and adaptation with water crises and large-scale involuntary migration; the cluster linking large-scale involuntary migration with a range of risks related to social and economic stability; and the cluster linking economic global risks with uncertainty around the impacts of the Fourth Industrial Revolution.

Figure 1.1: The Changing Global Risks Landscape 2015–2016: The 10 Most Changing Global Risks

Source: Global Risks Perception Survey 2014 and 2015, World Economic Forum.

Note: We are presenting the 10 global risks assessments that have changed the most since the *Global Risks Report 2015*. To identify them, we take the distance between the two years for each risk, in absolute terms.

Coping with the Changing Climate

Climate change and water crises, which have featured prominently in the Global Risks Landscape over the last five years, are joined this year by large-scale involuntary migration. The links among these risks appear clearly in the Global Risks Interconnections Map 2016 (Figure 2), and the intertwined challenges are unfolding against a background of many socio-economic pressures.

As illustrated by the Global Risks Interconnections Map, climate change and water risks are intricately linked to food security concerns – a subject explored further in Part 3 of this *Report*. About 70% of the world's current freshwater withdrawals are used for agriculture, rising to over 90% in most of the world's least-developed countries.[4] Carbon dioxide also causes ocean acidification, which makes it harder for small shellfish to form the calcium carbonite shells they need to grow – with implications rising up the food chain, threatening the availability of food from the seas as well.[5]

Challenges around water management are already immense. On the one hand, over a billion people lack access to improved water. Some 2.7 billion – or 40% of the world's population – suffer water shortages for at least a month each year.[6] The Organisation for Economic Co-operation and

Figure 1.2: The Top Five Global Risks of Highest Concern for the Next 18 Months and 10 Years

Source: Global Risks Perception Survey 2015, World Economic Forum.

Note: Survey respondents were asked to select up to five risks of highest concern for each time frame. The percentage indicates the share of respondents who selected the specific global risk among the five risks of highest concern for each time frame. See Appendix B for more details. To ensure legibility, the names of the global risks are abbreviated; see Appendix A for the full names and descriptions of the risks.

Development (OECD) estimates that 4 billion people could be living in water-scarce areas by 2050. According to the World Water Council, 80% to 90% of the scarce water in many of the world's arid and semi-arid river basins is already being used, and over 70% of the world's major rivers no longer reach the sea.[7] On the other hand, inadequate sanitation exposes 2.4 billion people to many diseases, such as diarrhoeal disease, which is the third leading cause of death among children under five.[8]

Governance – at global, regional and national levels – lies at the heart of water management. Even many developed countries are failing to proactively address water vulnerabilities, instead reacting only after extreme weather events. In developing countries, the political challenges inherent in water infrastructure and conservation projects are exacerbated by greater financing challenges.

Brazil exemplifies the challenge of managing water even within a single country: it has 12% of the planet's freshwater reserves, mostly in the Amazon region, but much of this water does not reach its urban population. Sao Paulo, which contributes a third of Brazil's GDP, has a lower water-per-capita availability than even the historically drought-prone north-eastern region of the country. With hydropower constituting approximately 64% of the electricity power load, there are conflicts caused by unclear rules about water governance at federal, state and basin levels.[9]

Water management is further complicated around the world by economic pressures – developing an economy can be a thirsty business, based on unsustainable use of water. As countries industrialize, more fresh water is needed for energy production – the United States allocates about 40% of its fresh water to energy, Europe over 30% – and the demand for water for energy and industry is forecast to increase by 70% by 2030 across Asia.[10] Globally, based on current trends, water demand is projected to exceed sustainable supply by 40% in 2030.[11] Adding to the pressures, agricultural production will have to increase in the coming decades to feed a growing population and a rising demand for meat.[12]

Unless current water management practices change significantly, many parts of the world will therefore face growing competition for water between agriculture, energy, industry, and cities. Tensions are likely to grow within countries, especially between rural and urban areas and between poorer and richer areas, and also potentially between jurisdictions. More than 60% of the world's transboundary water basins lack any type of cooperative management framework. Even where such frameworks do exist, they often do not cover all states that use the basin.[13] Interstate tensions over water access are already apparent in some parts of South Asia, and could impact the evolution of the international security landscape, as discussed in Part 2.

Climate change will only exacerbate these challenges. The latest Intergovernmental Panel on Climate Change (IPCC) report, in November 2014, reaffirmed that this warming in the climate system is "unequivocal" and that human influence is "extremely likely" to be the dominant cause. Atmospheric concentrations of three major greenhouse gases (carbon dioxide, methane and nitrous oxide) are at their highest level in 800,000 years, with CO_2 concentration up 13% since 1990. The world today is estimated to be about 1°C warmer, on average, than it was in the 1950s, and the effects are being felt. Regional analysis of the Global Risks Perception Survey shows that declining water availability features as the most likely risk in the Middle East and North Africa and South Asia, and the likelihood of extreme weather events is considered especially high in North America, South Asia and East Asia and the Pacific (see Figure 3).

Scientists caution that a total warming of 2°C implies a high risk of catastrophic climate change that could damage human well-being on a global scale. Yet even if each country meets

its Intended Nationally Determined Contributions plans, submitted to the United Nations Framework Convention on Climate Change (UNFCCC) and agreed at the Paris Climate Conference in December 2015 (Box 1.2), warming is projected to reach 2.7°C by 2100.

Given these developments, it will, therefore, be impossible to live without adaptation – but adaptation planning is complicated by the difficulty of predicting not only the expected degree of warming but also the expected pace. One source of uncertainty is the Arctic feedback loop – will ice sheets collapse slowly or rapidly? The average sea level is already rising by 3 millimetres per year, faster than any other time in the last two millennia; many of the world's cities lie on the coast or on river banks, with poor neighbourhoods most likely to be in low-lying areas vulnerable to flooding.[14] Another source of uncertainty is the "Amazon Dieback" scenario: recent oscillation between unusually dry years and heavy flooding could be an early indicator of irreversible system phase change.[15] If the Amazon stops absorbing carbon and starts releasing the estimated 120 billion tonnes of carbon it holds – equivalent to 15 years' worth of 100% fossil fuel emissions – the impact will be global.

Failure to address climate change and water crises will forcibly displace more people – the IPCC warns that droughts and coastal floods could cause "large-scale demographic responses – for example, through migration". Forced displacement is already at an unprecedented level, causing severe humanitarian challenges, as explored in the following section.

Box 1.2: The Paris Agreement: A Historic Turning Point on Climate Change

The adoption of the Paris Agreement on 12 December 2015 by 195 governments is a major turning point in the global fight against climate change. The world's nations agreed to limit global average temperature rise to "well below 2°C above pre-industrial levels and to pursue efforts to limit the temperature increase to 1.5°C above pre-industrial levels". They also agreed to a review mechanism that will help ratchet up efforts every five years from 2018, as well as a floor for financial flows to developing countries.

The Paris outcomes are far more ambitious than had been expected – a collective recognition of the dangerous risks posed by climate change as well as the cost of inaction. These outcomes are also sending unmistakable signals to the global markets that governments are willing to put aside their differences and do their part in tackling this biggest of global challenges.

In the coming months and years, the impact of the Paris Agreement will be felt in board rooms, banks and stock exchanges across the world. The expectation is that, as a result, trillions of dollars needed for investments will be unlocked to put the world onto a climate-safe pathway. The time has come to pivot from business-as-usual.

One of the innovations that emerged from Paris was the official recognition of the role played by business, investors, cities and provinces in driving and delivering climate action. Effective mobilization of these constituencies – alongside civil society and faith-based groups – has indeed contributed to this successful outcome. But such mobilization was possible only because an ever-growing number of global businesses and cities today understand that deepened globalization has heightened vulnerabilities through global supply chain shocks. And that these disruptions could be further triggered by climate volatility and policy uncertainty.

To date, nearly 190 governments have submitted their climate action plans, covering over 95% of total global emissions. These efforts alone will not suffice, as even the most optimistic estimates suggest that these pledges taken together would contain warming only to 2.7°C above pre-industrial levels. But these bottom-up efforts will provide a solid foundation from which ambition can be ratcheted up in the coming years.

Developments in the real world will also help, with cost-competitive alternatives already available today. In 2014, renewables made up over half of total energy investment, while the cost of solar panels has fallen by 75% and that of batteries for electric vehicles by half since 2009. Wind-generated electricity in over 50 countries is now at grid parity – when the customer of electricity pays the same to buy wind energy as to buy traditional technologies.

Looking forward, global attention will turn firmly towards implementation and developing specific action plans to deliver a low-carbon, climate-resilient world. With a clear direction of travel, the immediate next step will focus on policy frameworks and incentives that will deliver the results, as well as on the consolidation and scaling of much-needed public-private cooperation.

For businesses, the Paris Agreement is a licence not only to implement climate-friendly practices but also to innovate and develop the next generation of solutions. The race is on for forward-looking businesses and governments alike to capitalize on these new business opportunities for growth and resilience.

Humanity on the Move

The Global Risks Landscape sees a noticeable increase in both perceived likelihood and impact of the risk of **large-scale involuntary migration.**[16] The definition of this risk includes forced migration caused not only by violence and conflicts, such as those driving the exodus from Syria and Iraq, but also for environmental or economic reasons. The risk is seen as more relevant in the next 18 months than the next 10 years (see Figure 1.2). However, it is strongly interconnected with other risks that are considered highly worrisome in the longer term: not only interstate conflict and state collapse but also climate change and water crises, as discussed above.

Global refugee flows have reached a level that is unprecedented in recent history. In 2014, 59.5 million people were forcibly displaced in the world, compared to 40 million at the time of World War II.[17] More than half of these recent refugees come from three conflict-ridden countries: Syria, Afghanistan and Somalia.[18] The trend is upwards: during 2014, the number of people displaced – 42,500 per day – was four times greater than in 2010. Although the recent crisis in Europe has dominated headlines, and is reflected in the risk being considered most likely in that region (see Figure 3), the challenge is global with most regions affected (see Figure 1.3).

Three factors increase the risks posed by involuntary migration. First, people stay in host countries longer than they used to. The average duration of displacement lengthened from nine years in the 1980s to 20 years by the mid-2000s.[19] Fewer than one in 40 conflicts is now resolved within three years, and more than 80% last for more than 10 years.

The longer people stay away from their home countries, the harder it is to return: often they have lost their livelihoods, family ties and physical property; furthermore, property rights issues for returning refugees can be complex. Protracted refugee situations become even more difficult when refugees are granted only limited socio-economic rights and opportunities, limiting their scope to reclaim livelihoods and dignity.

The lack of effective integration policies in most countries (see Box 1.3 for an example) can lead to the formation of ghettos or isolated communities on the margins of society, ripe for frustration and vulnerable to disenchantment and even radicalization. In Europe, the rapid inflow of migrants in 2015 challenged local financial and absorption capacities and exacerbated the trend towards polarization of societies and the political spectrum, which in turn undermined the efficiency of European governance structures.

Second, the global humanitarian architecture is not able to effectively respond to today's challenges. Many countries, including some of Syria's neighbours, have either not signed the Geneva Convention governing the status of refugees, or do not uphold it because there is no enforcement mechanism. Without formal refugee status, refugees can find it harder to access formal employment, social assistance or travel documents.

The institutional architecture for refugees focuses on providing a short-term response to people displaced by conflict and violence. It assumes refugees will settle in camps and primarily need humanitarian assistance, whereas most now settle in urban areas[20] – where humanitarian actors have not yet developed well-functioning operating models – and primarily need resilience building. Moreover, the Geneva Convention does not cover environmental migrants, whose numbers are expected to rise for reasons explored above.

Third, most forced migrants move to other developing countries, where social and governance systems may already be weak or likely to fail (see Figure 3). In 2014, 86% of refugees lived in developing countries and about 12% in least-developed countries. In emerging economies, resource constraints can be significant: the UN estimates the cost of housing Syrian refugees in Jordan to be over 7% of Jordanian GDP.[21]

All these factors, if unaddressed, can fuel risks in host and destination countries. Although research on the economic effects of refugee inflows is limited, it suggests that refugees can make a positive contribution to the host country's economy through increased demand, inflows of remittances, promoting the use of technology and engaging in international trade.[22] In advanced, ageing economies, incoming refugees can contribute to keeping aggregate demand high and the workforce stable.

Multistakeholder approaches that include local business communities can contribute both to mitigating risks that could emerge from large-scale involuntary migration and to building

Figure 1.3: Global Displacement Hotspots, 2014

Source: UNHCR 2015b, p. 3.

Note: A "hotspot" is defined as a country or area that has been suffering from conflict-related displacement flows during the reporting period.

resilience in transit countries and countries of destination. Measures to consider include work permits and access to jobs, skills recognition and training, and access to schools and public health services. At the same time, at the global level, the development community could help by focusing more strongly on building resilience and helping refugees to transition into self-reliance. This will be even more important in light of the slow and unstable growth the world is currently experiencing, which may further limit countries' absorptive capacities.

Economic Growth 4.0

Fiscal crises in key economies, asset bubbles, and structural unemployment and underemployment are among economic risks rated as both highly impactful and likely; another global systemic financial crisis is rated as somewhat less likely than last year, but similarly impactful. Taken together, these risks could result in another economic slowdown with knock-on effects on employment and, ultimately, social stability.

Economic concerns are currently centred on the corporate and public debts built up by emerging markets in the recent low-interest rate environment: the International Monetary Fund (IMF) estimates the extent of corporate over-borrowing at up to US$3 trillion,[23] and the corporate debt to GDP ratio rose by 26 percentage points between 2004 and 2014 for this group of countries.[24] Particular risks could emanate from China, where continued credit-based measures to address concerns about a slowing economy could further heighten vulnerability to a financial crisis.

Box 1.3: Refugees in Malaysia

Since the 1980s, hundreds of thousands of Rohingya, a stateless ethnic and religious minority from Myanmar, have sought asylum in nearby countries, including Bangladesh, Thailand and Malaysia. In recent years, an increasing number of Rohingya people have fled by boat: 25,000 people departed from the Bay of Bengal just in the first quarter of 2015. Over 50,000 Rohingya refugees are registered with the United Nations High Commissioner for Refugees (UNHCR) in Malaysia,[1] with thousands more unregistered. The situation in Malaysia is at once a protracted refugee situation – with multiple generations of refugees, some of whom have achieved moderate de facto integration – and a humanitarian crisis marked by a steady influx of emaciated and traumatized asylum-seekers.

The legal status of refugees in Malaysia is tenuous: the country has not ratified key international agreements (most notably the 1951 Refugee Convention and its 1967 Protocol), and it lacks a legal and administrative framework for responding to refugees. While the UNHCR has primary responsibility for refugees – including registration and documentation – there are significant gaps in protection and assistance. Refugees cannot attend Malaysian schools, face barriers accessing healthcare, and confront a range of security and protection risks, including detention.

Despite these challenges, refugees invariably show a vibrant entrepreneurial spirit, undertaking formal and informal work to support themselves and their families, at restaurants and retail shops, schools, factories and farms, operating their own small businesses, cleaning, collecting goods to recycle and working in skilled professions, for instance as electricians. Specific examples include refugees opening tea shops with the help of Malaysian acquaintances, opening grocery shops that serve as meeting places for other refugees, and opening home day care for Malaysian children in the neighbourhood. However, restrictions prohibiting them from undertaking employment legally mean that most resort to difficult jobs for low pay, and their illegal status leaves them vulnerable to abuse and exploitation.

Rohingya refugees seek to improve their lives and livelihoods over the course of protracted displacement in various ways. They adopt skills and techniques – such as learning the local language and negotiating with authorities – to help them secure employment and make their way. Contrary to the widespread perception that refugees are a burden for the country of asylum, only a small proportion of refugees in Malaysia receive formal assistance from non-governmental organizations or the UNHCR; instead, most find innovative, albeit challenging, ways to support themselves and their families. They rely primarily on support from other refugees, community associations, and members of the host population to manage shocks, find work, overcome bureaucratic barriers and gain access to institutions. In the absence of formal social protection and services, Rohingya refugees have begun to develop their own: refugee-run community organizations, for example, register members, issue marriage certificates, operate convalescent shelters and help refugees find work.

Although it is important to recognize what refugees can do for themselves, the livelihoods of even the most successful are precarious. Many have relevant and transferable skills and a genuine desire to bring something to the communities in which they live, yet there is a marked dissonance between what refugees stand to contribute and the restrictive policies that limit their ability to do so. Addressing this gap requires a shift away from seeing refugees as passive victims or recipients of assistance or goods to understanding them as active agents pursuing lives and livelihoods in an extremely challenging environment, and in doing so contributing to the countries where they seek asylum.

Note
[1] UNHCR 2015a; UNHCR 2015c.

Concern is growing over debt levels at a time when long-term global economic prospects are expected to remain weak as a result of a worldwide slowdown in productivity growth over the past decade. In the short term, lower commodity prices and further appreciation of the dollar could pose balance sheet risks to both public and private sectors in countries with a high share of debt denominated in US dollars; in emerging markets, dollar-denominated corporate debt issued in 2015 stands at US$120.5 billion in 2015.[25] Also plausible is an increase in risk premiums on investments in emerging markets, which have been compressed in recent years. Interest rates are likely to go up in future, which could undermine the sustainability of high debt and lead to reversals in capital flows.

The result could be numerous corporate and potentially sovereign defaults in emerging markets, triggering a financial crisis and further slowing growth. In turn, slower growth in emerging economies could further reduce commodity prices, exacerbating exchange rate shifts.[26] With declining liquidity in financial markets in emerging market economies,[27] a crisis in an emerging market could spark volatility in global financial markets, leading to a global economic slowdown (see Box 1.4). This would accentuate risks associated with unemployment and the weak fiscal position of many key economies.

In developed countries, concerns remain about debt levels – mainly public – creating another vulnerability in the interconnected global economy. National economic crises can spark global slowdowns, but international governance does not have mechanisms in place to address the underlying risks, which are under the purview of national economic policies. Because any country could be a weak link, it is critical to strengthen resilience in all countries.

Box 1.4: China's Financial Vulnerabilities and the Transition to the New Normal

Because of its sheer size and rapid development, China plays a prominent role in shaping the global economic landscape. The country is now at a critical juncture as it transitions to a new phase of its economic development – referred to as a "new normal" by President Xi – in which its economy is based less on investments and exports and more on consumption and services. In the new normal, the Chinese economy will be more driven by market forces; it is expected to grow more slowly than its recent annual average of 7%, but more sustainably. However, whether this transition will be orderly is uncertain.

Uncertainty centres on the massive corporate debt built up by traditional industries that drove China's last two decades of growth but now face lower demand. The IMF estimates, for instance, that, at the end of 2014, the ratio of total liabilities to equity in China's construction sector exceeded 250;[1] in the oil and gas sector, the ratio has more than doubled since 2007, albeit from a lower base.

China's financial sector is another, related cause for concern. The Chinese banks that fuelled the rapid credit growth in now-declining industries consequently face worsening asset quality and non-performing loans. Their profitability has plummeted over the past year, adding to concerns about the fragility and vulnerability of China's underdeveloped financial system – which is dominated by large state banks and casts a large shadow banking sector. The central bank's intervention in August 2015 to weaken the renminbi could increase the risks of capital outflows, making funding and liquidity conditions for banks even tougher. It could also exacerbate the risk of default of Chinese companies that borrowed in foreign currency.

The government faces a dilemma. If it tightens credit conditions, it could reduce investment more quickly than consumption can increase to compensate, and cause massive defaults among struggling and heavily leveraged companies. This could mean a much more severe economic slowdown, potentially causing a surge in unemployment and social unrest. However, if the government lets more credit flow to avoid these destabilizing defaults, it risks further increasing the indebtedness of underperforming industries and creating bigger problems down the line. The government seems to have opted for letting more credit flow: in October 2015, the central bank lowered its benchmark rates and relaxed reserve requirements for banks.
The hope is that more of the new liquidity will flow to productive service-based activities and high-end manufacturing that will yield higher returns and accelerate the transition to the new normal. Mitigating the risks of this further increase in debt, China still has policy buffers to absorb financial shocks – it has a relatively favourable fiscal situation, including low debt and large foreign reserves. This allows the central government to be lender of last resort for heavily indebted local governments, state-owned banks and enterprises; to intervene to stabilize the stock market; or to adopt stimulus plans.

However, overreliance on these buffers could exacerbate existing vulnerabilities and impede the transition process. Instead, the government should invest in improving the nascent safety net to boost consumption in a country where, on average, households save about 30% of their disposable income, one of the world's highest.[2]

Notes
[1] IMF 2015d.
[2] Roberts 2015.

With longer-term trends such as demographic changes and rising wealth disparities likely to heighten economic and social pressure in emerging economies over the next 10 years, there is renewed urgency to generate growth. As explored in the *Global Competitiveness Report 2015–2016*, productivity – the major driver of growth – has been declining in recent years.[28]

Many hope that emerging technologies will fuel a new wave of productivity and growth. The pace of innovation is increasing and the spread of technologies is inevitable,[29] giving rise to individual innovations and disrupting business models, processes and products in ways that will require rapid adaptation.[30] A recent study suggests that internet-related technologies such as mobile internet, automation of knowledge work, the Internet of Things and cloud technology will be the most disruptive and generate the most economic benefit (see Figure 1.4).[31]

The failure to understand and address risks related to technology, primarily the systemic cascading effects of cyber risks or the breakdown of critical information infrastructure, could have far-reaching consequences for national economies, economic sectors and global enterprises. By one estimate, European countries that do not react appropriately to technological change could lose 600 billion euros in value added over the next 10 years, corresponding to about 10% of Europe's industrial base.[32] Businesses, policy-makers and civil society therefore need to find appropriate frameworks to address four high-level risks associated with the transformation towards a more digitized economy.

First: cyber-related risks. Cyberattacks and related incidents have been entering the global risks landscape as among the most likely and most potentially impactful risks for the past two to three years – in North America, cyberattacks ranks as the most likely risk by far (see Figure 3) – with the potential threat for doing business explored further in Part 4. Cases have been rising in both frequency and scale. They have so far been isolated, concerning mostly a single entity or country, but as the Internet of Things leads to more connections between people and machines, cyber dependency – considered by survey respondents as the third most important global trend (see Figure 4) – will increase, raising the odds of a cyberattack with potential cascading effects across the cyber ecosystem. As a result, an entity's risk is increasingly tied to that of other entities. As cyber dependence rises, the resulting interconnectivity and interdependence can diminish the ability of organizations to fully protect their entire enterprise. As more organizations move to digitize their unique business value within more connected environments that rely more and more on machine learning and automated decision-making, cyber resilience takes on a new importance. Although organizations may recognize the benefit of cyber technologies for their bottom lines, they may not be fully internalizing cyber security risks and making the appropriate level of investment to enhance operational risk management and strengthen organizational resilience. Particular attention is needed in two areas that are so far under-protected: mobile internet and machine-to-machine connections. It is vital to integrate physical and cyber management, strengthen resilience leadership and organizational and business processes, and leverage supporting technologies.

Second: the exchange of data between countries and stakeholders. Data have been called "the oil of the 21 century", and a predictable legal framework is needed to realize the full economic potential of digitization. Recent cases of policy reversal have created uncertainty about the legal situation, which can hamper investment and adaptation of the latest technologies. Given the inherent international nature of data flows, in areas such as supply chains or 3D printing, national governance needs to be complemented by a functioning international legal framework. However, the current regulatory regime is underdeveloped and lacks the necessary legal certainty in areas such as privacy, transparency, encryption control, the effect of intellectual property regimes on data that cross borders, and the impact of proprietary data on competition. Given the many actors and industries involved and the competing interests at stake, stakeholders will probably struggle to find common agreement. Moreover, the physical infrastructure for data exchange, such as undersea cables, could also become a target in international conflict or terrorism.

Third: changes to the work environment. Although there is a lot of uncertainty about how many new

Figure 1.4: Estimated Potential Economic Impact of Technologies, US$ trillion, annual

Source: Based on Manyika et al. 2013.

Note: Projections are to 2025 and include sized applications and consumer surplus.

Box 1.5: Pathways to Resilience: Effective Leadership and Institutional Values

Global risks recognize no geographic boundaries. Whether from natural or man-made or cyber disasters, the cascading effects can be felt oceans away. Escalating terrorist attacks in Africa, Europe and the Middle East; natural disasters related to climate change; and health disasters from infectious diseases increasingly impose both economic and human costs. How can the global community prevent or mitigate the adverse effects of catastrophic events in our increasingly complex and quickly evolving environment?

The Global Agenda Council (GAC) on Risk and Resilience advocates four key activities for companies, organizations and governments to build resilience at national and global levels.[1] These recommendations resulted from a detailed study of entities that proved to be resilient in recent disasters, including Nepal's 2015 earthquake, the 2014 Ebola outbreak and Chile's 2010 earthquake, along with an assessment of data from four sources including the Organisation for Economic Co-operation and Development, the U.N. Office for the Coordination of Humanitarian Affairs, the World Bank and the Zurich Insurance Group.

1. Clarify roles and responsibilities. During a crisis, it is critical to have clearly delineated and understood senior official and c-suite executive roles and responsibilities for risk and incident management. Confusion around "who is in charge" or "who has authority" wastes crucial time and resources, and makes response and recovery less efficient and effective. The need for well-defined roles becomes heightened when an organization faces novel or rapid-onset disasters or emergencies, such as those resulting from cyberattacks. Pre-determining, training and exercising roles, capabilities and plans helps to ensure an organization's risk readiness. The successful management of complex crises also requires a capacity for adaptability and flexibility. Crisis managers must be able to adjust pre-established plans as needed given the unique characteristics of the crisis.

2. Develop Crisis Leadership Characteristics. Organizations that successfully position for, respond to and recover from major events also consistently have effective leadership – the qualities and actions of those with authority and influence can empower their entities to be resilient. Such leaders are steady and decisive in the face of uncertainty and pressure. They make decisions in a timely and prioritized way, and communicate them transparently. Recognizing that they cannot address risks alone, they galvanize others and are clear about what assistance they require. They understand when a disaster requires them to cut through policies that may prevent or delay action. Leaders who are effective during and after a crisis are those who have earned trust through their demonstration of openness, transparency, responsiveness and accountability. They are seen as honest and standing up against corruption. For example, an IMF assessment attributes much of Chile's effective recovery from the 2010 earthquake to the nation's "technocratic, rules-based, and transparent" leadership – and to its institutional practices, including the rule of law.[2] Another example is seen in Norwegian Prime Minister Jens Stoltenberg's speech in the wake of the July 2011 terrorist attacks in Norway, which demonstrated how leadership during a crisis can significantly result in both increased trust in government and meet citizens' expectations of responsiveness. These examples also highlight the role of meaning making – that is, the capacity for leaders to make sense of an adverse event and articulate to the public a clear path forward in a state of emergency.

3. Leverage expertise. When confronted with an unprecedented emergency, strategic crisis managers must be able to quickly identify and mobilize the most relevant and trustworthy expertise to help understand and respond to the crisis. Knowledge management systems and expert networks need to be set up in advance and across multiple sectoral, professional and disciplinary boundaries. Understanding the implications of the crisis beyond the immediate consequences and anticipating the potential pathways of cascading effects requires appropriate crisis management structures that enable additional expertise to formally support decision-making. For example, the United Kingdom's Scientific Advisory Group in Emergency (SAGE) is an independent support group that provides science-based expertise for the management of complex and unprecedented crises to the UK cabinet. Access to such expert "force-multipliers" could help both public and private entities understand and address the unique aspects of a crisis. Having access to specialized expertise is especially crucial for novel or multi-faceted evolving crises – such as the Great East Japan Earthquake, which impacted the Fukushima nuclear reactor and caused many companies to struggle with what decisions to make.

4. Create a culture of integrated risk management and multistakeholder partnerships. Another necessary institutional value is the recognition of the scope of global risks and the need for partnerships to address them. A culture of risk management – the beliefs, norms and values that underpin daily actions – must span the whole organization, including its supply chains. Entities can no longer afford to have different types of risks managed by different policies and operating procedures and by different officials, executives and agencies. All parts of an organization must collaborate transparently on risk management through integrated planning because of the potential for risks to have cascading consequences, including spillovers between the virtual and physical realms – for example, a flood disabling a server farm, or a cyberattack interrupting electricity supply.

Individuals and organizations must recognize the imperative to contribute to resilience and must also know what and how they can contribute. No single entity – public or private – possesses all of the necessary authority, resources, or expertise to ensure its resilience against catastrophic events. Instead, resilience necessitates collaborative approaches. Public-private partnerships that harness the core competencies of each sector have a critical role to play in strengthening resilience capacity and maximizing the benefits of investment in risk monitoring, business continuity planning, and disaster preparedness. Instilling a culture of collaboration will enable effective partnerships before, during and after disasters. For example, in Germany, the LÜKEX Strategic Crisis Management Exercises conducted every two years by the federal government are designed to address complex crises and their potential disruptive consequences across sectors through cascading effects. LÜKEX involves a large partnership between the public and the private sectors to build a culture of crisis management and trust across multistakeholder partnerships.[3]

Notes

[1] "Resilience" is defined as "the ability of a system, community or society exposed to hazards to resist, absorb, accommodate to and recover from the effects of a hazard in a timely and efficient manner, including through the preservation and restoration of its essential basic structures and functions." UN Office for Disaster Risk Reduction (UNISDR) 2009; see http://www.unisdr.org/ we/inform/terminology.

Further information about the GAC on Risk and Resilience can be found at http://www.weforum.org/content/global-agenda-council-risk-resilience-2014-2016-0

[2] Chile's extraordinary comeback has been recently analysed in detail to provide leaders from around the world with concrete lessons they can apply when they face their own national crisis. See Useem, Kunreuther, and Michel-Kerjan 2015.

[3] OECD 2015 http://dx.doi.org/10.1787/9789264249127-en

types of jobs new technologies will create and what they may be, it is likely that more existing categories of jobs will be computerized. The US Bureau of Labor Statistics estimates that, by 2022, 47% of US workers will have a high probability of their jobs becoming automated.[33] Examples include robots taking over manual tasks in online retail stock keeping, healthcare and diagnostics, and checking in hotel guests, while knowledge workers in non-routine cognitive tasks could be displaced by advances in intelligent algorithms. The entire employment system may have to be re-thought to facilitate transitions between different types of jobs. Skills in STEM (science, technology, engineering and mathematics) are expected to increase in importance in the medium term, with longer-term needs projected to focus on skills such as creativity, problem-solving and social intelligence.[34]

Fourth: widening wealth, income and social inequalities. Access to technology is likely to exacerbate income differences within and across countries, with those who adapt gaining and those who do not losing income. Four billion of the planet's 7 billion people still do not have access to the internet and may not be able to gain from technology-driven growth. Currently the distribution of income is largely determined by employment: advancing technology could diminish returns to labour and lead to wealth accumulating in fewer hands. Excessive inequality lowers aggregate demand and threatens social stability, and can increase risks such as involuntary migration or terrorism caused by violent extremism. Rising inequality is also correlated to upticks in security problems, such as violent deaths or robbery.[35]

There is a role for public, private and civil society organizations in building resilience to the risks explored in this part of the *Report*. In Box 1.5, the World Economic Forum's Global Agenda Council (GAC) on Risk and Resilience shares the results of research on what makes organizations resilient.

Conclusions

Every year *The Global Risks Report* seeks to remind readers of the varied interconnections between seemingly diverse global risks. As well as the interconnections explored in the three risk clusters above, each nexus of risks can also be linked back to the new status quo of heightened geopolitical and global security concerns: environmental stresses could increasingly see tensions among countries over access to water and land; mass forced migration can be both a symptom and a cause of cross-border tensions; and emerging technologies are set to transform the international security landscape, alongside many others. The next part of this *Report* turns the focus to how the global security landscape has and may continue to evolve.

Endnotes

[1] "COP21" refers to the 21st session of the Conference of the Parties, also known as the 2015 Paris Climate Conference.

[2] The risk of interstate conflict has decreased somewhat this year, but remains in the upper right quadrant of the landscape for a second year in a row. In 2014, the two risks were assessed as significantly less important.

[3] Water crises is classified as a societal risk, but it is related to both the environment and society at large.

[4] UNESCO 2015.

[5] See for example, the United Nations Environment Programme report on ocean acidification (UNEP 2010).

[6] http://www.nature.org/newsfeatures/pressreleases/study-over-2-billion-people-affected-global-water-shortages.xml

[7] http://www.worldwatercouncil.org/fileadmin/wwc/Library/WWVision/Chapter2.pdf ("The Use of Water Today", World Water Council – Chapter 2)

[8] Key facts from the Joint Monitoring Programme of the WHO/UNICEF 2015 report are available at http://www.wssinfo.org/fileadmin/user_upload/resources/JMP-2015-update-key-facts-English.pdf

[9] OECD 2015b.

[10] US number:
US National Renewable Energy Lab, part of US DoE http://www.nrel.gov/analysis/workshops/water_nexus_workshop.html "39% of all freshwater withdrawals made in the United States is dedicated to the production of electricity through fossil fuels and nuclear power." Also "http://www.ncsl.org/research/environment-and-natural-resources/overview%20ofthewaterenergynexusintheus.aspx" http://www.ncsl.org/research/environment-and-natural-resources/overview ofthewaterenergynexusintheus.aspx "41% of freshwater drawn in the United States is for thermoelectric generation." These figures are necessarily estimates and may rely on different assumption based on region and /or methodology.
EU number:
European Waters: Current Status and Future Challenges – a Synthesis, European Environment Agency 2012
Asia number:
Research undertaken by Columbia University Water Centre for the World Economic Forum Water Initiative Report

[11] 2030 Water Resources Group. 2009.

[12] The UN World Water Development Report (UNESCO 2015) suggests that by 2050, agriculture will need to produce 60% more food globally, and 100% more in developing countries.

[13] UNEP 2002.

[14] Many of the world's cities are on the coast or on the banks of major rivers. The World Bank and the OECD forecast that average global flood losses in coastal cities will multiply from US$6 billion per year in 2005 to US$52 billion a year by 2050 with just the socio-economic costs of floods, such as impact on population and property value, taken into account. Add in the risks from sea-level rise and sinking land, and global flood damage for large coastal cities could cost US$1 trillion a year if cities do not take steps to adapt.

[15] In 2010, Amazonia experienced a record-breaking dry year as it did in 2005 (two 1 in 100 year events). In 2009 and 2012, Amazonia experienced the other extreme with heavy flooding (two 1 in 500 year events). See Nobre and Castilla-Rubio 2012 and Borma, Nobre, and Cardoso 2013.

[16] In the context of the discussion on migration and refugees, it is crucial to differentiate between voluntary and involuntary migration and also the drivers of migration flows. In the following section we refer only to involuntary migration as defined by the *Global Risks Report* (see Appendix A: Description of Global Risks and Trends 2015).

[17] UNHCR 2015b. This estimate comprises internally displaced people, refugees and asylum seekers. However, the share of refugees in the total population is higher in 1940, as the population amounted to about 2 billion vs. 7.3 billion today.

[18] UNHCR 2015b.

[19] Loescher and Milner 2011.

[20] UNHCR 2015b.

[21] IMF 2015a.

[22] Betts et al. 2014.

[23] IMF 2015a.

[24] IMF 2015c.

[25] Dealogic.

[26] IMF 2015a

[27] IMF 2015a.

[28] World Economic Forum 2015.

[29] Brynjolfsson and McAfee 2011.

[30] Schwab 2016.

[31] Manyika et al. 2013. At the same time, the application of some of these technologies (nanosats, autonomous drones, cloud and Internet of Things) coupled with machine learning and artificial intelligence along with fast-improving technologies will create a step-change improvement in the dynamic decision support capabilities urgently needed by governments, businesses and communities in dealing with the complexities and risks associated with the climate-water-energy-food-land nexus at appropriate spatial and temporal dimensions, particularly in emerging economies and the broader developing world.

[32] Bundesministerium für Wirtschaft und Energie 2015.

[33] Frey and Osborne 2013. Carl Benedikt Frey and Michael Osborne of the Oxford Martin School, University of Oxford, have estimated that 47% of US jobs are potentially automatable over the next decade or two.

[34] Frey and Osborne 2013.

[35] Aitken and Elgar 2011.

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Part 2: The Security Outlook 2030

The international security landscape is in flux, challenging the assumption of continued social, political and economic progress that characterized the first 25 years after the end of the Cold War. Transformative shifts in political and economic power – accelerated by technological innovation, social fragmentation and demographic shifts – will have profound ramifications for the international security order (see Box 2.1 for the Forum's definition).

Box 2.1: International Security Defined

"International security" refers to the measures taken by state or non-state actors, individually or collectively, to ensure their survival and integrity against transboundary threats.

The Security Outlook 2030 initiative was launched by the World Economic Forum in November 2014 (see Box 2.2). This initiative harnessed foresight methodology to identify the drivers of future security landscapes and their implications. Ten multistakeholder workshops were held in six different regions of the world, and interviews were conducted with security experts and practioners. The process resulted in the definition of seven drivers and three scenarios featured in this *Report*.

The Security Landscape in Context

The landscape is characterized by two main phenomena: first is the vacuum created by *frail or weakening states*, which open up space for the rise of armed non-state actors in the global security space and create difficult spillover crises.[1] The rise of well-organized, armed non-state actors demonstrates a departure from the traditional Westphalian notion of the role of the state. This occurs in two

Part 2 was contributed by Espen Barth Eide, Anja Kaspersen and Isabel de Sola from the World Economic Forum.

Box 2.2: A Deep-Dive into International Security

Geopolitical uncertainty shows no sign of letting up, with new crises cropping up and protracted conflicts spilling over throughout 2015. It should come as no surprise, therefore, that geopolitical and international security risks are top of mind for executives, leaders and the wider World Economic Forum ecosystem. For three years in a row, *The Global Risks Report* has registered the growing concerns of leaders over international security: in 2014 and 2015, geopolitical risks shot to the top of the most likely and impactful risks. More than ever before, understanding geopolitics and international security is central to mitigating and building resilience to global risks.

The Forum therefore initiated a year-long, in-depth study to examine current trends and possible driving forces for the future of international security. Its purpose was to take a fresh look at how we assess international security risks and ensure greater preparedness. In parallel with the *Global Risks Report* project, the Forum convened over 250 constituents who could provide unique insights on international security–related matters from different angles. The project harnessed foresight methodology to identify the drivers of future security landscapes and their implications.

As summarized in Box 2.4, the seven driving forces that emerged from this consultation map closely onto the risks and trends identified as key by the 2015 Global Risks Perception Survey and discussed in Part 1 of this *Report*. Based on the findings of the special consultations on international security, this part of *The Global Risks Report* surveys the current international security landscape and points out two phenomena – failing states and strategic competition – that are transforming geopolitical and international security affairs. It also puts forward three scenarios for the international security landscape to 2030.

By drawing out the drivers and risks, the Forum aims to inform discussions among a broad range of stakeholders on the international security challenges of the future. This dialogue should ultimately be able to bring an agenda to the institutions empowered to take measures to defuse existing and emerging conflicts, and help to identify shared interests, build confidence and drive policy on a global scale.

ways: they position themselves as an alternative to traditional state-based governance structures, as a "non-state state", and they challenge the state monopoly of violence.[2]

Second is the return of strategic competition between strong states with conflicting interests. The two phenomena may seem contradictory but are in fact related: when instability leads to the breakdown of existing orders, openings are created that regional or global powers may seek to exploit to improve their positions. Likewise, competition between states may impede effective responses by global institutions to crises or problems, which then fester and worsen. Indeed, the confluence of weak states and competitive strong states has created security threats outside the mandates and capabilities of most international security arrangements and institutions. The fragmentation of states was the principal security concern in the period after the end of the Cold War. In contrast to the tense but stable superpower standoff that ended with the fall of the Berlin Wall, the conflicts of the 1990s and the 2000s were perceived to be "asymmetrical", with technologically inferior but innovative adversaries challenging government security forces.

Although this phenomenon persists, we are now witnessing the rise of hybrid conflicts – situations where both classical and asymmetric threats coexist and reinforce each other. States and armed non-state actors learn from each other. Innovative combinations of conventional low-tech and novel high-tech tactics create unpredictable dynamics. The modern "battlefield" blurs the distinction between zones of war and zones of peace, as well as that between legitimate combatants, non-traditional adversaries and civilians. It is hard to measure the impact of war, but conservative estimates suggest that, in 2014, around 180,000 people were killed in 42 armed conflicts around the world[3]. Indirect deaths and costs caused by war-related malnutrition, displacements, trauma, disease and preventable illnesses raise the toll even higher. Today more than 6 million people have been forcibly displaced by war and related distress, and the numbers keep growing.[4] Deaths from terrorism are also on the rise; in 2014 alone more than 32,000 people were killed in terrorist attacks in 93 countries.[5] The indirect costs of both trends, not only the human cost, are significant.

In some parts of the world, states themselves direct violence against citizens, or support terrorist activities abroad, in order to attain and promote their own security objectives. In these cases the state becomes the driver of insecurity, rather than the guarantor of peace and stability, leading to a further erosion of trust and confidence of citizens, violations of human rights, and increased pressure on neighbouring states who may be forced to absorb refugees or – either explicitly or inadvertently – find themselves harbouring insurgent groups.

The competition for influence between great powers of today resembles the Cold War period, but with important differences.[6] Today's world is more multilayered than multipolar: states are

Frail States

under pressure not just from outside, challenged by their own citizens, as discussed in Part 3 of this *Report*. Leaders may consequently delay dealing with risks emerging from the reconfiguration of international relations, and ideology is no longer a primary driving force. Strong, weak-willed states are challenged by smaller, strong-willed players, shifting the traditional notions of balance of power.

The current geopolitical and international security context, as demonstrated in this *Report*, makes clear that chronic and resurgent violence, conflicts, and economic and social volatility will remain prominent features of the current and future reality. The rising flows of people on the move as a result of greater insecurities represent only one of the symptoms of a deep-rooted and protracted systemic governance crisis, underlining the need for a transformative shift in how international affairs are managed.

With each passing year, it also becomes clearer that many actors are no longer aligned to a status quo defined by a selective United Nations (UN) Security Council. The assumption that shared values are a necessary basis for regional or multilateral arrangements may give way to alliances and arrangements defined by shared interests. With dwindling institutions of global governance, there is a growing role for public-private collaboration to tackle global security challenges (see Box 2.3).

A Tour of the Current International Security Landscape

The phenomena shaping the international security landscape are well illustrated by the challenge of Daesh, or the self-proclaimed Islamic State in Syria (ISIS). Although the territory it controls lies in Syria and Iraq, Daesh has recruited fighters from over 100 countries – partly through advanced marketing using popular social media platforms.[7] In its recruitment strategy, Daesh exploits the resentment and disillusionment of young people, offering jihadism as an exciting anti-establishment cause. It also has local roots – including, it is assumed, some forces of Saddam Hussein's regime demobilized after the 2003 invasion of Iraq as well as individual wealthy regional sponsors.

Many countries are engaged in the fight against Daesh: recent terrorist attacks from Ankara to Beirut, Tunis and Paris, with copycat attacks in other far corners, illustrate how the battlefield has become globalized. There are no simple ways to defeat Daesh. It will not be defeated as long as civil war rages in Syria – and civil war will continue to rage in Syria for as long as the powers that could end it disagree about what the endgame should be. Daesh is banking on the inability of major regional and global powers to set aside their differences and pragmatically find a political settlement that all would prefer to the status quo. So far, despite laudable recent attempts to build a common front, this calculation of diplomatic inefficacy seems well-founded.

Military solutions, however, can go only so far.[8] Aerial bombardment without a coherent strategy for long-term stability may merely extend the vacuum in which terrorist groups can thrive. Daesh also needs to be suffocated socially and economically. And to prevent it – or something like it – appearing again in another guise, its appeal to significant numbers of young men and women all over the world needs to be understood and undermined.[9]

In the meantime, the situation in Afghanistan and its neighbourhood is regressing as security and territorial gains made by US-led coalition forces over the past decade have been lost to resurgent Taliban and al-Qaeda fighters.

The spillovers from weakening states are affecting other regions. Violent and extremist groups are also at work in parts of the Sahel, northern Nigeria, the Horn of Africa, the African Great Lakes area and the Central African Republic. At the time of writing, other countries too are facing political tensions leading to violence. Burundi faces worrisome political tensions, which raises the risk of further severe civil unrest and inter-ethnic violence. Elsewhere in Africa, economic growth continues despite serious security and social problems. Properly managing the demographic youth bulge in Africa will be critical for security outcomes, implying major investments in skills building and job creation.

Latin America likewise faces governance challenges, with organized criminal gangs gaining influence over many aspects of society in various countries, as a steady stream of drugs continue to flow from the region into the United States, Europe and Africa. Latin America is at a crossroads.[10] The combination of slower growth prospects, increasing social unrest and political instability combined with high levels of violent crime pose serious security challenges for the region. Several processes are underway in order to foster a region-wide security dialogue and establish cooperation mechanisms to address growing criminality, violence and insecurity.[11]

Strategic competition between states is raising the stakes. In the South and East China Seas, territorial disputes are far from resolved. Growing economic interdependence in a region lacking commensurate security architectures increases anxieties about the region's ability to peacefully manage a potential misstep or overreach by one of the players. The key question here is how the region – and the wider world – relates to China's rise, and indeed how China itself adapts its own policies as it emerges into one of the primary centres of political and economic might. A major transformation is underway in China's armed forces, emphasizing expeditionary, air,

Box 2.3: Public-Private Collaboration in Complex Crises

We have entered a new era, and it is not a peaceful one. Emerging conflicts and long-term violence are seriously impacting people, social fabrics and political systems. There has been a rise in de-structured conflicts and violence – often fought in densely populated urban areas – and international humanitarian law is repeatedly and systematically violated.

The lines between conflict and non-conflict zones are increasingly blurred, with pockets of vulnerability coexisting with pockets of progress. The lines are also blurred between criminal, inter-communal and politically motivated violence. More refugees and internally displaced persons are forced to flee for longer periods of time. Conflicts, mismanaged migration, poor governance and corruption are eroding gains from economic growth and development, affecting both low- and middle-income countries.

New models of public-private collaboration need to be promoted to support, finance and deliver immediate assistance and alleviate long-term needs, with business collaborating closely with frontline responders on responsible investment to strengthen state and societal resilience.

maritime and space technologies over its traditional emphasis on the Army and the defence of the home turf. The further development of a security mitigation apparatus that has its core in the Association of South-East Asian Nations (ASEAN), but which has an even broader reach through its regional cooperative framework, is of particular importance. For instance, the evolving ASEAN Code of Conduct for maritime disputes, while not attempting to solve the underlying competing claims, is an attempt to avoid escalation into conflict.

As illustrated by its new security legislation and the long-standing debate about revising Article 9 of its constitution, thus allowing for a larger military role abroad, Japan's security posture is evolving, potentially allowing for a more assertive Japan in regional and international security frameworks. India, while currently occupied with pressing domestic issues of internal conflict and social inequality, is also a key actor to watch as the Asian security landscape adapts to a post-Western world.

Europe has remained united over the Ukraine crisis, despite initially struggling to deploy sanctions against Russia because of its strong links in energy and finance. An ever bigger challenge is presented by the refugee crisis, a clear testament to the loss of state control and the frailty of intergovernmental structures. Insularity, xenophobia and right-wing populism are gaining ground across the continent, calling into question the integration process and a common European front on international security policies. If Europe proves unable to find common solutions to today's pressing challenges, we might see a de-integration process unravelling achievements such as the Schengen passport-free zone, the common currency, or even the Single Market. While still unlikely to happen, such a process could hardly be expected to be harmonious and peaceful.

Meanwhile, the role of the United States in international security remains a source of uncertainty and contention. Many question whether or not the United States has the will and the means to remain the world´s dominant superpower, and whether or not it can uphold a Western, liberal agenda for the entire international system. Recent attempts to design an American foreign policy based on alliances, norms and international cooperation rather than unilateralism cannot be secured by the United States alone but require that other key actors also engage in upholding international order. The role played by the US Congress in how the United States is perceived on the world stage and the growing domestic polarization weakens the predictability of the country as a global actor – which risks causing discord between the United States and the rest of the world, its allies included.

As an energy power, and possessing the world's second largest arsenal of nuclear weapons, Russia will continue to play an assertive role in the geopolitical order. Following the annexation of Crimea, there is no clear political solution in sight to the continuing tensions in eastern Ukraine. EU-US sanctions combined with the low price of oil have hurt Russia's economy, but have so far not achieved the desired policy shift. Other great powers' desire to contain Russia collides with the desire for cooperation against the threat of Daesh. Russia's future hangs in the balance between modernization and reliance on raw materials exports, with the current leadership increasingly looking East for politico-economic ties. Western countries, having reduced their investments in defence and being preoccupied with internal concerns, may find that they lack the resources and will to implement their long-term strategic objectives.[12]

Trust is waning in the capacity of existing multilateral mechanisms to resolve potential flashpoints. In their current form, global institutions such as the UN retain their relevance as meeting places, but they do not necessarily have the capacity and credibility to effectively uphold peace and security. The UN was designed for a very different world. The UN-centric intergovernmental "contract" needs a significant overhaul if it is to successfully mitigate the challenges and threats currently facing international security.

The Geo-Economics of International Security

International economic relations, international security and geopolitics are closely related. When relations between states are harmonious, trade and investment patterns are typically driven by economic considerations. However, in times of tense relations between states, politics may trump economics – for instance, through the introduction of sanctions against adversaries or preferable treatment for political allies.

After decades of rapid globalization, the current geopolitical landscape shows some signs of returning to politics dominating economics. The economic growth spurred by globalization has shifted the balance of economic power, leading to renewed great power rivalry and global insecurities. New alliances are playing out in trade agreements, strategic infrastructure projects, new investment banks, and arrangements governing the internet and cross-border data flows and storage – increasingly a source of tension, as seen with the annulment of the Safe Harbour Act agreement.[13]

Economic policies are increasingly "weaponized", and not only through sanctions. Tools that were taken for granted in the era of globalization – such as access to raw materials and technology underlying financial transactions – may become politically restricted, posing new risks for industries that rely on free and open markets for access to technology, materials and customers. Businesses may find more and more obstructions as a result of anxieties around trade, technology transfer and intellectual property, calling into question the reliability of global supply chains, industrial partnerships and cross-holdings.[14]

Civil wars and terrorism can disturb the flow of goods and services, with the interconnectedness of the global economy magnifying the impact. Ninety percent of traded goods travel by sea, often through stretches of water in Asia and Africa that are increasingly part of territorial disputes or targets of piracy: the Suez Canal, the Strait of Malacca, the Gulf of Guinea and the Strait of Hormuz – thoroughfares for trade, energy transport and supplies – are all surrounded by violent conflicts.[15] Air transport costs are increasing because of heightened travel security procedures and the need to avoid overflying conflict areas. As discussed in Part 3 of this *Report*, epidemics can also threaten international security, with the recent Ebola crisis a reminder of potential vulnerabilities.

Driving Forces and Amplifiers

The Forum's year-long consultations on international security identified seven key driving forces of change in the international security landscape (see Box 2.4). They are highly interconnected, each interacting with and affecting the others. From the seven, two stand out as warranting more detailed discussion: technological innovation and natural resources and climate management. They are not only drivers in their own right, but also significant amplifiers of the others.

Technological Innovation and International Security

From longbows to gunpowder, nuclear weapons, airplanes and drones, the history of international security is also the history of technological innovation,[16] and the history of humanity is defined by war, and war by the people who fight it and how they fight it.[17] The Fourth Industrial Revolution will profoundly affect our security, physically and virtually. Previous industrial revolutions have advanced human development but they also precipitated violent transfers of power. Technological innovation will continue to influence how conflicts arise, who fights them, where they are fought and how they are settled.

Some ways in which new technologies will impact international security in the coming 15 years can already be anticipated: for example, improved capacity to 3D-print weapons from digital templates and new possibilities for biological and chemical weapons. However, technologies are fusing in increasingly unpredictable ways, and potential nefarious uses are not always immediately apparent. Even if they were, innovation quickly outpaces the capacity for regulatory oversight. Breakthroughs in a range of technologies – from robotics to nanotechnology, artificial intelligence, genome sequencing, human advancements or meta materials – could destabilize security and shift balances of power.

Until recently, the ability to inflict large-scale damage required either armies of people or sophisticated equipment, such as nuclear weapons, effectively available only to states. With the Fourth Industrial Revolution,[18] large-scale damage is possible for small groups and even individuals working from home computers or labs. Existing tools to prevent the escalation of disputes – treaties, conventions, or doctrines such as "mutually assured destruction" – are of questionable use when destructive capacity is no longer limited to a handful of entities with broadly similar resources, tactics and interests in preventing escalation.

The internet has opened a new frontier in warfare: everything is networked and anything networked can be hacked.[19] The "dark net" has become a trading place fuelling insecurity. Every future conflict will have a cyber element, and some may be fought entirely in cyberspace. Given that attack is easier than defence in cyberspace, this will dramatically change how the entire security apparatus prepares for potential breaches. Physical distance no longer offers protection; many technologies are dual-use; much critical infrastructure is privately owned; and attacks are easy to disguise given the challenges of attribution. Social media is already a significant tool in hybrid warfare,[20] offering a new means for all sides to a conflict to conduct cy-ops and psy-ops,[21] including scare tactics, recruitment and fundraising.[22]

The seabed and space are both also likely to become increasingly militarized, as more and more actors – state and commercial – have gained the ability to send up satellites or mobilize unmanned underwater vehicles capable of disrupting fibre-optic cables and satellite traffic. Off-the-shelf quadcopter drones are already being used by gangs to spy on and attack rivals. Autonomous weapons, capable of identifying targets and deciding to open fire without human intervention, will become increasingly feasible, challenging the laws of war.

Box 2.4: The Seven Driving Forces of International Security

Technological innovation: Emerging technologies create challenges, but also opportunities to solve them.

Resources, climate management and security: Tensions are raised by growing competition over access to resources including energy, water and food.

Efficient governance: Corruption and lack of transparency or rule of law limits the progress of development and destabilizes societies.

Geo-strategic competition: Shifts in economic and political power and weakened mutual trust lead great powers to compete for influence, often creating competing spheres of influence.

Demographic shifts: Countries may struggle with bulges of youth or elderly populations, or with rapid influxes of migrants.

Social cohesion and trust: Fuelled by inequality, feelings of social exclusion, mistrust and marginalization threaten social stability.

Hybrid and asymmetric threats: More complex threats, indistinct adversaries and "black swans" are arising from a more interconnected world.

Natural Resources, Climate Change and International Security

Climate change is expected to amplify existing security problems and create new ones. As explored in Part 1, the world will increasingly feel its effects: extreme weather events including prolonged high temperatures and droughts, freak storms and floods, and rising sea levels threatening coastal cities and island countries are expected to occur more frequently and at greater scale, touching many countries, especially those already grappling with poverty, fragility and ineffective governance.

The likely impact of climate change on food security, explored in depth in Part 3, is another channel of impact on the international security landscape. As wells dry up, crops and fisheries fail, and people lose their livelihoods, simmering tensions between social groups are more likely to boil over into community violence. Armed non-state actors, including insurgencies and terrorist groups, will be able to leverage this new source of insecurity as an additional grievance on which to build their narratives, finding new recruits among those made destitute.

Stresses on water and food could contribute to rising tensions among states. Trade may be interrupted by the hoarding of commodities, local populations can object to foreign control of arable land, and arguments may erupt over rights to draw water from rivers and aquifers that cross borders.

Box 2.5: Scenarios Methodology

What are the most pressing issues leaders should address? What trends are driving transformations? To be as prepared as possible for the future, leaders need to think broadly and consider the worst that could happen.

Strategic foresight enables assessments of what the future context might look like through carefully researched and validated scenarios. Scenarios extrapolate existing trends to provide insights that can inform more robust decision-making. The three scenarios presented here (Figure 2.5.1) describe how the seven driving forces of international security could interact and how prominent actors might respond. The collaborative process of developing and using scenarios can generate the relationships necessary to drive change.

During a year-long initiative, launched at the Annual Meeting in 2015,[1] over 250 members of the World Economic Forum's network participated in consultations to build the scenarios. To ensure a broad perspective, our team conducted 10 workshops in six regions, with participants from government, the security sector, academia, civil society, youth, and the business sector, which together comprised 41% of the total number of participants (see Figure in the Acknowledgements section). A full list of contributors is included in the Acknowledgements.

Note
[1] Eide and Kaspersen 2015c.

Figure 2.5.1: Illustrations of the Scenarios

Interstate tensions are also likely to be stoked by an increase in migration into countries less affected by the changing climate. Environmental stresses will accelerate migration across borders and also to cities, putting additional stress on urban infrastructure in many countries. Cities will need to find new tools and policies to manage security risks.

Security Outlook 2030: Three Alternative Scenarios

The potential for rapid and radical change, even though the form it takes is unknown, raises fundamental questions about planning and preparedness. In this section, three scenarios describe potential evolutions of the international security landscape to 2030 (see Box 2.5 for a description of the methodology used). These are not intended to be predictions, but plausible trajectories that can usefully challenge current thinking and serve as a call to action for the development of more adaptable and resilient response systems.

Future 1: Walled Cities

As greater penetration of information and communications technology broadens the horizons of citizens in many countries, raising expectations in areas such as health, education, infrastructure and quality of governance. At the same time, fiscal challenges are reducing governments' ability to meet citizens' expectations – and citizens become disillusioned by their exposure to public sector corruption, poor service delivery and ineffective institutions.

This scenario foresees widening inequalities of wealth, income, health, environment and opportunity continuing to pull communities apart. In wealthier nations, the middle classes are hollowed out by declining wages and dwindling public goods. Those who can afford it are increasingly retreating to gated communities and turning to the private sector for what were once public services, divorcing their interests from the common good.[23] Fertile soil, fresh water and even clean air become increasingly commoditized and traded between those who can afford them. With economic and political elites feeling ever more identical and distant from citizens, states lose their ability to bring people together around a shared narrative or identity. Trust is eroded, as is the social contract between citizens and government.

The vitality of many states is challenged by demographic trends. In some regions, large youth populations come of age with few opportunities for stable, well-paid employment. In other regions, the demographic bulge is of the elderly, creating ever greater needs for finance for pensions and healthcare; this puts pressure on declining working-age populations and limits the resources available for states to address security issues.

Social cohesion is further weakened by mass migration, as youth seek economic opportunities and humanitarian or environmental catastrophes displace people. In the absence of narratives that foster a shared identity and common cause, mismanaged migration flows and poor integration of migrant communities create tensions. Anxiety over migration fuels the rise of extremist, xenophobic and ethno-nationalist political parties that advocate for a return of authoritarian government and national identities based on culture, ethnicity or religion, effectively exploiting narratives of "us" vs. "them".

As younger populations spend more of their lives online, they fill the need for shared narratives and a sense of community with like-minded people, sometimes in faraway geographies. Meanwhile, millions of children are coming of age in refugee camps, often under duress, and with no natural sense of belonging. Rootless and disillusioned, often traumatized by growing up amid civil wars or community violence, more young people become anti-system and vulnerable to recruitment by violent groups or gangs.

Insurgencies, terrorist groups, and criminal organizations all exploit the security deficit, leveraging new technologies to strengthen their hands against strained security forces. Overwhelmed by internal threats, states double down on internal security issues and disengage from multilateral collaboration, reducing the effectiveness of global institutions and mechanisms.

In some areas, lines between states and violent non-state actors blur. Terrorist or criminal groups, often in opaque alliances, seize control of more territories and run them like states, threatening nations and even regions with collapse. The corridor between South America and Mexico, Iraq and the Levant, and swathes of West and Central Africa are among the areas now under pressure from combinations of civil wars, humanitarian crises, violent extremist activity, crime and gangs.

More and more frequently, legitimate non-state actors and organizations fill some of the spaces left by weakened national governments, often with social support. Companies and private charities fill the void and manage what were once public services. With their operations located near desperate communities, many companies are drawn into addressing the social consequences of insecurity and violence. Eroding state power also increases city power, with cities coming to be regarded as the most practical, functional unit of governance.[24]

The world divides into islands of order in a sea of disorder. As large numbers of people are displaced by environmental change and social violence, still-functioning states seek to protect themselves, often deploying private military and intelligence apparatus to minimize risks of involvement in protracted conflict. In this scenario, by 2030 the world resembles medieval times, when the citizens of thriving cities built walls around them to protect themselves from the lawless chaos outside.

Future 2: Strong Regions

An alternative scenario envisages the volatile and competitive interregnum paving the way for the emergence of a stable world by 2030 with several seats of power.

In this future, as wealth accumulates in the South and East, more players are able to make strategic economic investments in diplomacy, critical technologies and infrastructures. The balance of power adjusts, creating a new order of mostly regionally based spheres of influence and interests that are generally accepted, as are newly evolved norms of engagement over political disputes and shared resources.

Far from their power being eroded, states in this world are strong – at times authoritarian. Strong leaders rise to power on promises to refocus on narrowly defined national interests, with minimum diversity and high solidarity for citizens. Narratives recalling (imagined) past glories and comforting homogeneity of ethnicity and creed become a strategy to compensate for the uncertainty of the future. As in the 1930s, leaders persuade their citizens to "escape from freedom": these leaders strictly control borders, forcefully curb migration, invest more in military and police, and persuade people to accept mass surveillance as the only way to be protected from deadly threats.

Overwhelmed by mistrust among states, governments invest their political, financial and diplomatic capital in bilateral and regional processes. Effective regional powers emerge, as do new alliances of convenience where shared interests transcend the regional perimeter. Global governance mechanisms continue to lose credibility. New forms of cooperation initially run in parallel with the established global architecture, gradually taking over roles including development, trade, finance, security and the internet. Counterintuitively, this proves to reduce competition between states: with contentious issues taken off the global table, states are able to rebuild enough trust to maintain stability at the international level.

For example, in this world cyberspace is neither open nor global. States establish further controls over the internet, sometimes in collaboration with allies, building their own capabilities in data storage, search, and infrastructure – and using security threats and the promise of better public services through big data to win popular support.[25] Climate change is another example: as its effects become clearer, states increasingly shift attention from cumbersome global efforts to more functional regional ones. The goal of saving all humanity from catastrophic climate change gives way to states and regions working together to adapt and protect "their own" citizens.

With bad memories of recent foreign interventions and increasing domestic polarization over foreign affairs, the United States refocuses its priorities and abandons its ambition to be the centre of the global stage, allowing others to fill the void on major political issues. China's "peaceful rising" no longer raises apprehensions among other powers; its prominence in East Asia becomes an accepted fact. ASEAN goes into a comfortable orbit around its giant neighbour, while Japan focuses on maintaining good trade relations. The United States and China mutually accept their economic relevance and shared roles and responsibilities in a new world order.

Sweeping aside any last resistance, Russia consolidates its sphere of influence in Central Europe and Eurasia. Europe – having rebuilt its economic partnership with Russia and consolidated links with the United States – develops several levels of integration and remains functional as a coherent regional trade bloc. Latin America and the Caribbean leverage their abundant resources and strategic location to consolidate into a regional bloc. The push for African integration continues apace, with two sub-regional integration blocs emerging as twin poles of influence. Following years of fruitless proxy conflicts in the Middle East and North Africa, two carefully balanced security alliances of functioning states restore some degree of order to the region.

Fifteen years into the future, this balance of regions and alliances is only beginning to consolidate as a new global order. Former rivals and enemies are tempted to test the boundaries, leading to strong pushbacks and reconfirmations from regional powers that the new order is here to stay. Security issues are handled by regional allies or relevant players, rather than at the global level.

Inevitably, there are losses for the global economy: geopolitical interests take predominance over economic ones, with corresponding inefficiencies as globalization goes into reverse. However, with the revolution in manufacturing and automation making it possible to produce goods closer to the consumer, there is less need for global trade in goods and less need to outsource production to low-wage countries. Companies must make costly and complex arrangements to be able to operate across regions; in many cases, abandoning international strategies, localizing or breaking up into smaller regional entities, prove to be more effective strategies.

Future 3: War and Peace

The final scenario envisages the world drifting into a major conflict during the next 15 years, which ultimately leads to a reworking of the global system.

In this future, established powers remain in denial about the major shifts of economic, demographic and political power that have taken place. Growing strategic competition between states erodes their trust in each other, and therefore their capacity to collaboratively resolve disagreements about the role of certain countries in certain regions: for example, the United States in the Asia-Pacific; Russia in Central Asia; and China in South-East Asia.

Meaningful progress slows on issues such as climate change, with global solutions blocked by states that calculate that taking action would be too problematic domestically, or that they could gain from new lands becoming suitable for crop production or resource exploitation. There is no longer consensus over the normative foundations or rules of the international system, which is not able to manage the rising tensions.

With stagnant growth and the rise of isolationist movements in established powers, space opens up for emerging powers to test the status quo. Meanwhile, internal pressures grow

in many countries: to varying extents, social turmoil erupts as emerging technologies put many people out of work and extreme weather events overwhelm the responsive capacity of governments. In some countries, upheavals feed into virulent nationalism, drawing on historical grievances against powerful neighbours.

Eventually, in this scenario, a major conflict erupts between two leading powers. One state experiences a massive cyberattack on critical infrastructure, causing loss of life. It accuses another state of complicity, and launches a conventional attack in retaliation. Denying any involvement, the second state considers it has been attacked without cause. Outraged populations on both sides demand further action; nervous leaders seek to shore up their positions and miscalculate the gravity of the consequences.

Other states are dragged into the escalating conflict and forced to choose sides. Armed non-state actors on both sides seek to leverage the conflict for their own ends, forcing the parties to the war not only to fight each other, but also to engage in hybrid conflicts against third parties.

Ultimately, the conflict stops short of all-out mutual destruction, but not before imposing high costs on both sides – human, economic, and infrastructure. The "nuclear taboo" – that states abstain from using the ultimate weapons, even if they possess them, still proves to hold true – but belligerents did begin to prepare for their application. There is no clear victor. In this scenario, the aftermath of the conflict leads to a sense of determination to prevent a repeat interruption to business as usual. The commonly accepted argument is that the lesson to be learned from the failure of previous global mechanisms to mediate conflicts is that those mechanisms were not only excessively ambitious but also largely ineffective.

States set about identifying the few basic practicalities that truly demand global cooperation: norms, for example, relating to the seas, air corridors, and finance. Because of their economic relevance, many of these norms are looked after by multistakeholder organizations, rather than intergovernmental organizations. Civil society and business leaders take on management roles in global arrangements. Other areas previously of interest to global governance institutions, from human rights and free trade to international development and control of the internet, are set aside as non-essential to the basic aim of preventing conflicts. The UN nominally retains a peacekeeping function in protracted conflicts, but is not able to regulate relations between leading states.

The result is a stripped-down global system in which the liberal ideals of freedom, democracy, justice and equality are no longer put forward as a paradigm to which all should aspire. A new entente emerges on respect for differences of political and economic approach, though this means accepting a degree of entrenched global inequality and disintegration, and a parcelling up of the global commons. Where they can, people and companies move to places that suit their objectives best.

Implications and Outcomes

Though none of the three scenarios presented here will occur exactly as described, the security landscape of the future may manifest multiple elements from one or more of the scenarios, probably simultaneously. Indeed, it can be argued that we have already entered the period of "walled cities", as the refugee crisis seems to lead some nations to the reflex reaction of closing borders – both physical and political – as described in Part 1.

The three scenarios may come across as somewhat dystopian, because they are extrapolations of existing, negative trends. The world does not need to arrive at these dystopias, however. Our collective knowledge, connectedness, technological advances and social innovations present endless opportunities to change the outcome and shape a more secure world, given strong leadership and the right decisions being taken at the international level. This last point brings us back to the purpose of this *Report*: to cast new light on decisions that need to be taken today. The following set of recommendations is intended to aid in envisaging possible futures and to help change control the trajectory we are on and improve the outcome.

Overhauling the Social Contract

Above all, these three scenarios point to the need to overhaul the social contract between citizen and state. Re-establishing trust in governance, improving the accountability of institutions and leaders, reducing social and economic divergences and delivering better services should be top objectives for policy-makers. In these areas,[26] technology is not only a potential disruptor but also a key enabler.

More effective governance alone may not suffice, however, without also building greater social cohesion. The fabric that binds citizens to the state and to each other is fraying. A critical task for the state is to reinforce notions of citizenship and narratives of inclusion within national discourse, which can pave the way for reconciling political and theological differences both domestically and internationally.

Rewiring Global Governance

All three scenarios reflect uncertainty around the future role and ability of global governance institutions to deliver on security. In an ideal world, a strong global body would have the tools and standing to mitigate conflicts involving either terrorism or competition between great powers, and to contain and resolve peripheral conflicts. At present, however, the multilateral system appears overwhelmed by the number and complexity of issues, and international mechanisms are often fragmented, co-opted or undermined by the special interests of chosen member states.

If states want to strengthen their ability to take collective decisions on key international security matters, they need to improve the efficiency of the multilateral apparatus. Progress on meaningful reform of the United Nations and the Bretton Woods Institutions to reflect current political and economic

realities has been slow and unfocused. Piecemeal reform of the system itself will not suffice: the choice is between implementing comprehensive reform to create the right mechanisms and responses for future global cooperation on security, and allowing the "death by a thousand cuts" of the global governance system – an outcome that would not favour international security.

Fostering Global Leadership

Today's world is in clear need of strong leadership, new compromises, innovative ideas and a capacity for long-term thinking. This is not limited to government and international organizations but also applies to civil society and the business sector. Because power is distributed among many sectors, multistakeholder cooperation is more important for tomorrow's security than ever before.

The digital revolution, at times a source of disruption, can also be a tool for enhanced transparency – and transparency, if genuine, offers the potential to rebuild trust.

As suggested by the "strong regions" scenario, beginning that process at a regional level, with new architectures that are parallel to the existing international system, could ultimately strengthen rather than undermine global stability.

Enhancing the Role of Cities

Refocusing some security efforts at the level of the city could be another contribution. As urbanization gathers pace, cities will increasingly rival states as the most natural level of government for harnessing technology to deliver public services and security. Cities have also proven their advantages as sites of innovation, employment creation and higher productivity, because they, at times, prove to be more focused on practical problem solving than on the "status and prestige" issues that tend to obscure interstate relations. Devolving resources from national to municipal levels and creating new ways for city leaders to collaborate on security matters may also be faster than reforming established mechanisms for multilateral collaboration among states.

Promoting Private Sector Engagement

A strong argument could be made for increasing the participation of the private sector as a stakeholder in international security.[27] The implications of security risks affect companies assessing where to invest and do business as much as they affect governments engaged in trade, diplomacy and maintaining the security of their citizens. Yet the potential of the private sector to contribute to peace and security is not reflected in global security mechanisms or at the multilateral level.

Businesses often see global security as a risk management and compliance issue. Limited understanding of one's own global, regional and local impact might sometimes even lead to inadvertently reproducing or confirming negative patterns in society and governance. The traditional business response to geopolitical skirmishes has been to view them essentially as intractable externalities: companies seek to minimize downside risks while waiting for a crisis to blow over. However, in a hyperconnected world, volatility in one place can have immediate repercussions on the other side of the globe. Avoiding investment in known or potentially volatile places does not insulate companies from the impacts of volatility. In today's world, companies might be well advised to understand their own potential to influence international developments.

Many companies are already dealing with the root causes of insecurity, directly or indirectly. From inefficient governance to corruption, environmental degradation, social disparity and unrest in surrounding communities, many companies have policies in place to protect their interests while also addressing these drivers of insecurity within their core areas of operations. For example, a mining company seeking to minimize environmental impacts on local communities, a telecommunications company training local workers in the skills they require and thereby also empowering those workers, and an infrastructure company working with local government to improve quality and transparency around public tenders may all be contributing towards addressing the drivers of geopolitical instability. Another way the private sector can contribute is through company norms that forbid involvement with corrupt practices; this may, over time, spur better governance and reduce social resentment.

Encouraging New Behaviour

Multistakeholder cooperation might also be conducive to mitigating the security implications of technological innovation. Ethical frameworks and norms guiding technological innovation could be elaborated between those actually involved rather than relying only on regulators, which will struggle to keep up with the pace of change in the Fourth Industrial Revolution. Likewise, common understandings about the security dimension of an increasingly connected world could involve key private and public stakeholders from both the emerging technology and international security spheres.

Viewing climate change through an international security lens also suggests several policy options where multistakeholder action is critical. These include the search for new mechanisms to reflect externalities related to resource scarcity or environmental effects, while simultaneously safeguarding social stability by guaranteeing affordable access to the necessities for survival. Public-private partnerships established to identify technological solutions to improve the efficiency and resilience of food production and water use is another example.

Conclusion: A Call for a Resilience Imperative

If the "new status quo" implies such a high presence of global geopolitical risks and realignment around interests rather than values, then a wider range of stakeholders needs to be involved in setting the direction of the new global security paradigm and implementing solutions.

A first step is for private sector leaders to place international security firmly on their radar screen. International security and geopolitical trends are likely to have

more influence on the global economy in the future, thus demanding greater strategic attention from business leaders. With a stronger understanding of the issues and their own evolving role in the geopolitical and global security landscape, the private sector can be a constructive partner in addressing many global security challenges and mitigating their driving forces.

A second step is to have the traditional security actors – including international organizations and governments – adjust their own frameworks and processes to build in more public-private participation at the most appropriate levels. The Extractive Industries Transparency Initiative, action taken by technological and social media companies to block terrorist and violent extremist activity, and business alliances for action on climate change are promising examples of public-private arrangements that can strengthen security.

Third, a renewed focus on prevention, preparedness and resilience, rather than reaction and compliance, would likely improve security actors' ability to manage known and unknown security risks. There exists important know-how and resources in the private sector that can improve preparedness and mission-critical planning processes in a global security context – using data to track the progress of risk factors, sharing information on where and when crimes occur, and establishing mechanisms for harnessing industry supply chains during complex emergencies – are a few examples of how security arrangements could be updated.

Rather than wait for crises to happen, or sleepwalk into the dystopian scenarios described above, it is critical to identify potential inflection points and focus on finding solutions rather than just containing problems, and adapt relevant structures accordingly. Prompting greater pliability through a genuine, forward-looking multistakeholder process in order to ensure against complacency and improve the outcomes in a fast-paced and interconnected world may be the best way to prevent the described dystopian futures from materializing.

Endnotes

[1] "Non-state actors" is a term widely used to describe everything from non-for-profit or commercial providers, non-governmental organizations across all thematics, community-based organizations and faith-based organizations. Their characteristics include sufficient power to shape and cause change, although they are not part of the established institutions of a state and are thus not accountable to the same standards as a state. In the global security context, however, the term is often used to refer to violent, criminal, terrorist and militarized groups or individuals with no ties to a state or state-like structures but who, through the use of asymmetric strategies of warfare, declare war on states and state actors. Non-state actors can also be a force of good in terms of their significant role and emphasis on a specific area of focus, usually on common goods, for the advancement and promotion of issues.

[2] Williams 2008.

[3] IISS 2015.

[4] UNHCR 2015.

[5] Institute for Economics and Peace 2015.

[6] Kaspersen and Shetler Jones 2015.

[7] See UN Security Council Report S/2015/358, at www.un.org/en/sc/ctc/docs/2015/N1508457_EN.pdf. Letter dated 19 May 2015 from the Chair of the Security Council Committee pursuant to resolutions 1267 (1999) and 1989 (2011) concerning Al-Qaida and associated individuals and entities addressed to the President of the Security Council dated 19th May 2015.

[8] Kaspersen 2015a.

[9] See Davis, Dusek, and Kaspersen 2015.

[10] Argueta de Barillas and Cassar 2015.

[11] Vision of Humanity 2015.

[12] Stoltenberg 2015.

[13] Schwab 2015.

[14] Blanke and Kaspersen 2015.

[15] George 2013.

[16] Kaspersen and Hagan 2015.

[17] Kaspersen 2015c.

[18] Eide and Kaspersen 2015b.

[19] Eide and Kaspersen 2015a.

[20] Hybrid threats and warfare refers to the blend of conventional, irregular means of combat and asymmetric tools, often with a strong cyber element, in military strategies facing indistinct adversaries and aggressors in a complex battle domain, complicating matters such as attribution and retribution.

[21] The term "cy-ops" refers to militarized cyber operations; "psy-ops" refers to military operations usually aimed at influencing the adversary mindset through noncombative means.

[22] Kaspersen 2015b.

[23] Nye 2014.

[24] Sally 2014.

[25] Beckstrom 2014.

[26] See also the World Economic Forum 2015b.

[27] De Sola and Kaspersen 2015.

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Part 3: Risks in Focus

The previous sections of this *Report* have explored the ways in which global risks are becoming more imminent, impacting more people's lives, economies and institutions. This part of the *Report* explores the Global Risks Landscape 2016 and the Global Risks Interconnections Map 2016 through a societal lens. Because well-functioning societies are at the core of international security and are key to strengthening resilience, this section presents an in-depth exploration of three distinct angles that relate to societies: the three Risks in Focus. To motivate action, each of the Risks in Focus includes examples of practical initiatives that can be implemented to build resilience.

One of the key risks related to the advancing digitization of societies concerns the tension between the ways in which technology is empowering citizens and the growing sense of political disempowerment felt by many of those citizens. Rising income disparity and a shortage of quality employment opportunities – that could be further exacerbated by the Fourth Industrial Revolution – along with extreme weather events and heightened migration flows are among the factors that could leave societies deeply unsettled.

Against this background, the first Risk in Focus introduces the concept of the **"(dis)empowered citizen"** and discusses potential consequences for social stability. The second contribution explores food security – a necessary condition for social stability – which is increasingly under threat from failure to mitigate and adapt to **climate change**; this Risk in Focus builds on the findings of Part 1. Finally, the third Risk in Focus discusses the potential of future **pandemics** to threaten social cohesion.

The world has navigated previous eras of profound transitions resulting from converging economic, technological and geopolitical developments. But with a faster pace of change and more complex interconnections, the stakes have never been higher.

3.1 (Dis)Empowered Citizen

Social Stability at Risk: Analysis

Social instability has re-emerged in recent years as a prominent concern. As discussed in Part 1, social instability is again the most interconnected global risk (see Figure 2), ranking in the top 10 over both 18-month and 10-year time horizons (number 5 on the 10-year time horizon; see Figure 1.1 and number 8 on the 18-month horizon, not displayed). Profound social instability additionally ranks among the three most likely global risks to occur in Latin America and the Caribbean and the Middle East and North Africa (see Figure 3).

Although statistics related to social instability vary – particularly because the terminology used to describe instability fluctuates widely – data suggest there has been a rise in protests over the past two decades. As illustrated in Figure 3.1.1, protest intensity has reached a new and higher plateau since the most recent spike, associated with the 2011 Arab Spring. The Global Database of Events, Language, and Tone (GDELT) Project notes "elevated protest activity of the last three years" in comparison to the previous "two decades of relatively reduced protest action."[1] Its data suggest we are again approaching 1980s protest levels, when causes of social turmoil ranged from Cold War tensions and anti-apartheid sentiment to the Tiananmen Square protests.

Social stability is being challenged by multiple and profound transformations that affect most countries worldwide. These transformations result from fast-paced technological progress, globalization, wealth and income concentration, shifting demographics, lack of job opportunities and a changing climate. Together they are creating new opportunities, expectations and sources of frustration. Social instability is not per se always a negative factor, because it can drive towards another and potentially better new equilibrium. Ensuring that these transformations result in positive outcomes will require profound changes to institutional and policy frameworks – but as citizens' demands become more sophisticated, they also call into question the capacity and willingness of political and business leaders to respond.

Societal Change Mechanisms under Pressure

Many societies try to channel the stress associated with societal transformations into constructive dialogue, enabling those affected to be and feel heard by their fellow citizens and those in authority. Common mechanisms for individuals to raise public awareness of issues and ask for change include organizing or signing petitions, donating to or joining social or political groups, and standing for election.

However, not all societies have constructive mechanisms in place to handle appeals for change. Faced with disquiet over societal transformations, some respond by closing down debate, deliberately or inadvertently stifling individuals and groups that question existing structures. To some extent, social stability is in the eye of the beholder: in some societies, a peaceful mass demonstration would be regarded as threatening, subversive

Figure 3.1.1: World Protest Intensity

Source: Computations and illustration by Kalev Leetaru, 2015, based on the GDELT data set (http://gdeltproject.org/).

Notes:

The World Protest Intensity score is the total number of protest events divided by all events seen that month. The timeline in this figure is created using data collected from print, broadcast, and web news media worldwide from over 100 languages (http://gdeltproject.org/). The data are normalized for the exponential rise in media coverage of the past 30 years.

Part 3.1 was contributed by Alexandra Lopoukhine, Silvia Magnoni and Nicholas Davis, World Economic Forum.

and provocative; in others, it would be regarded as an example of constructive change mechanisms working as they should.

It is not clashing attitudes per se that cause social instability – there will always be citizens demanding change. Rather, social instability can emerge when transforming attitudes come up against institutions that are unsuccessful in their struggle to peacefully incorporate them into the broader social and political context. Around the world, trust in institutions is plummeting. The most recent edition of the *Edelman Trust Barometer* found that in a higher proportion of the surveyed countries than ever before in the barometer's 15 year history, people were distrustful of both governments and businesses. Even NGOs are not immune – although they still command more trust than the public or private sector, the 2015 *Edelman Trust* study showed a declining sense of trust in those entities, too.[2]

Social Stability at Risk

The global risk of social instability is heightened by uncertainty about whether existing structures will be able to constructively resolve pressures when (dis)empowered citizens' demands threaten to undermine a country's political stability (see Box 3.1.1 for a definition of (dis)empowered citizen). With more (dis)empowered citizens organizing and mobilizing, governments and businesses alike need to come to terms with the ways in which they may be exacerbating the root causes of citizen discontent. They must understand the risks and work out how to adjust to a changing operating environment and a new societal landscape.

Beyond economic uncertainty, the risks for countries include: (1) undermined legitimacy of the government mandate; (2) increased social polarization; (3) political impasse and the impossibility of actuating reforms, where relevant; and – under more severe circumstances – (4) possible disintegration of a country's governmental system and other cascading risks that might easily emerge in a truly globalized, interconnected and complex world. An inclusive society with empowered societal actors who are aligned behind a joint vision for the country is a strong signal that a state is stable and confident, with greater transparency, lower corruption and a stronger rule of law – all important factors for doing business.[3]

From an economic perspective, businesses benefit from a stable social and political environment for running their operations. They operate according to forecasts and scenarios that factor in socio-political risks, and instability increases their operational costs, reduces margins on investments and undermines local networks. Social and political unrest can cause losses in revenue, property damage, roadblocks, bureaucratic delays, overall economic slowdown and an unconducive business environment. For businesses, more specific risks include (1) reputational risk and other dangers to brands; (2) potential loss of market share; (3) product boycotts; and (4) disruption of established business models.

Particular risks to businesses may arise when local contexts and relationships change when people feel unable to effect change as citizens and look for ways to do so as consumers. Business models consequently need to adapt to new demands and expectations. Increasingly customers want to know not only about a business's own performance in areas such as child labour and environmental impact, but also about the operations of its entire supply chain. They expect to have a voice in all aspects of its operations, from how production processes are set up to how distribution operations are developed and investment decisions around community initiatives are taken.

Box 3.1.1: The (Dis) Empowered Citizen: A Definition

The term "(dis)empowered citizen" describes the dynamic that is emerging from the interplay of two trends: one empowering, one disempowering. Individuals feel empowered by changes in technology that make it easier for them to gather information, communicate and organize. At the same time, individuals, civil society groups, social movements and local communities feel increasingly excluded from meaningful participation in traditional decision-making processes and disempowered in terms of their ability to influence and be heard by institutions and sources of power.

Drivers of (Dis)Empowerment

Social structures around the world are being transformed on three levels. First, at the individual level there are changes in how people feel and how they perceive the world and identify with particular values; this is combined with people's increased ability to express and transmit their views, which in turn influences behaviour. Second, at a collective level, rapid changes in how social groups form and solidify have taken place, and in how these groups debate and develop common values and viewpoints and how they interact with other stakeholders. Third, often driven by and in response to the individual and collective levels, formal institutions such as governments, businesses, religious institutions, the media and civil society organizations are also changing the way they relate to and interact with both groups and individuals.

These evolving structural forces create new patterns of communication, relationships, collaboration and expectations, which in turn – in combination with emerging technological, economic, political and environmental drivers – create new structures of empowerment and disempowerment.

Economic Drivers
Many countries have recently seen mobilizations against inequality, persistent unemployment and deteriorating economic environments. From the Arab Spring to the anti-austerity protests in Europe, people have vocally rejected the consequences of what they perceive as a distorted and non-inclusive economic and political system. Demands for reforms to tackle corruption, in both

politics and business, are being heard across the globe. Policies that neglect or deepen inequality can exacerbate the combination of less sustainable economic growth, weakened social cohesion, and citizens feeling disenfranchised from democratic processes.

Environmental Drivers
Changes in society, regulatory policies and business practices are crucial to address our changing climate. In recent years a "climate justice" movement has emerged from frustration with a lack of leadership, evident in international negotiations characterized by long talks, vested interests and the ultimate incapacity to curb the effects of global warming, despite progress at the COP21. Continued sluggish progress or a lack of any progress at all will increasingly fuel protests, especially as extreme weather patterns make a progressively greater impact.

Political Drivers
The last three years have seen more elections and government collapses in major market economies than in all of the previous decade.[4] Approval ratings of political leaders are sagging, and established political parties across Europe are facing declines in membership and a need to reconsider how they engage with the electorate.[5] Labour unions are not doing any better: although increasing in Asia and South America, membership has been declining in Europe and North America, particularly in the United States, where the unionized workforce hit a 97-year low in 2013.[6] A proliferation of alternative political parties – some of them extremist or nationalist – has challenged established governance systems without necessarily delivering the outcomes hoped for by citizens in terms of improved transparency and equality. Indeed, a high turnover of governments or strong separatist movements can end up making policy-making less stable and worsen distrust in governance structures.

The perceived inability of governments to respond to major global challenges – from climate change and internet governance to food security – is eroding confidence in authorities. Combined with a sense of diminishing separation between the private and public sectors, governments are perceived to be either unable or unwilling to regulate the activities of large corporations, for example by closing tax loopholes. Political leadership is seen to be colluding with, or even interchangeable with, business leadership, as "revolving door" practices shape the relationship between business and government. Citizens' view that their own voices are being ignored by political leaders is exacerbated – even apparently validated – by the perception that the wealthy enjoy privileged access to decision-makers.[7]

Technological Drivers
Technology amplifies dissatisfaction caused by other drivers. Social movements are facilitated by digital tools that allow the individual citizen to be heard and also allow rapid mass mobilization, cyber-activism and globally connected social movements that span traditional geographic and political boundaries (see Box 3.1.2).

While voter participation rates are steadily declining, especially among the young, digital technology is providing new ways for people to mobilize and challenge existing power structures to articulate an alternative. This was most visible in the 2011 wave of youth-led revolts from North Africa to South America, but there is general evidence of an increase of citizens' movements worldwide in the past couple of decades. Studies of online content dating from 2010 and 2012 indicate a positive relationship between political content and youth who were previously politically disengaged.[8]

Online protests, strikes, cyber activism, and online petitioning and boycott campaigns are increasing. For example, the online activist and petition network Avaaz.org grew by around 40 million members in eight years, and Change.org now has 80 million users. Although some cynicism exists around "clicktivism", which can be seen as merely a form of virtue signalling, such web-based activist organizations have often complemented online activism with offline activities,[9] thereby amplifying their impact. As the world becomes more connected, mobile and networked, protests that might once have been geographically limited can spread ever more widely and quickly.

Repressive Reactions Fuel Social Disruption

Clear arguments can be made for governments to oppose some citizen movements, such as those that disregard human rights.[10] In most cases, however, many different perspectives on what constitutes the social good can be valid. To establish trust and ensure broadly sustainable development, a country's businesses, citizens and government need jointly to elaborate a common viable national vision.

Rather than looking for ways to win back public trust, however, many governments have eroded that trust further by responding harshly to protests: closing down space for civil society, demonizing protestors and harassing activists. In recent years, the space available for citizens' actions has shrunk in many countries. The CIVICUS *Civil Society Watch Report* shows that core civil society freedoms of expression, association and peaceful assembly were violated to a significant degree in at least 96 countries during 2014.[11]

Technology is empowering governments as much as citizens, notably to employ surveillance tools on their own populations – and sometimes those of other countries. In some cases, governments breach their own laws, as with the British intelligence agency spying on international NGOs outside of proper procedures.[12] Increasingly laws are being reformed to legitimize data collection and cyber oversight, such as Canada's Bill C-51, which originally called for removing barriers to sharing security-related information.

Just as protestors are learning tactics from one another, anti-protest legislation is often inspired by experiences in other countries. A growing number of governments have implemented similar measures imposing limits on peaceful assembly and protest, narrowing the definition of what is considered permissible civil society and media activity, banning civil society organizations from receiving foreign funds for certain activities, and making new registration inordinately complex. CIVICUS has drawn attention to the shrinking space for civil society

Box 3.1.2: Digital Government Technologies: The (Persisting) Challenges of Inclusiveness and Engagement

The ability to leverage technology to improve relationships between governments and citizens depends on citizens being able to use that technology. In OECD countries in 2012, for instance, less than a quarter of people aged 65–74 said they interacted electronically (internet portals, social media) with their government, compared to more than half among the 16–24 age group on average across the OECD (Figure 3.1.2.1). To fully exploit the potential of digital technologies, governments should take steps to address existing digital divides and avoid the emergence of new forms of e-exclusion. As well as age, gaps persist in the level of uptake by education level and living area.

The two main reasons for e-exclusion are lack of physical access and limited technological skills. Therefore, alongside the development of a well-functioning digital government infrastructure, a crucial component of an effective digital government strategy is action to increase the population's ICT literacy, raise awareness of existing online opportunities and boost the comfort and familiarity of all age groups with the use of digital channels to interact with governments. A multi-channel approach to service delivery, providing services by various offline (e.g. in-person contact, postal mail) and online means (e.g. websites, mobile-based applications) in an integrated way, is more likely to guarantee access to public services to all citizens.

Figure 3.1.2.1: Citizens Using the Internet to Interact with Public Authorities by Age Group, 2012

Source: OECD ICT Database; Eurostat Information Society Statistics (database).

Governments can take further steps to use digital channels to foster engagement through the full policy-making cycle. Most governments still view social media as an additional tool to broadcast traditional communication messages. According to a recent OECD survey, fewer than one in four governments try to leverage social media for more advanced purposes such as transforming public service delivery or opening up public policy processes to key stakeholders.[1] The 2014 OECD's *Recommendation of the Council on Digital Government Strategies* provides principles for governments to harness new technologies to increase openness, transparency and inclusiveness of processes and operations, and to foster greater citizen engagement and empowerment. Government bodies need to identify and support businesses and citizens who can form a digital government ecosystem that promotes dialogue and exchange.

One important development has been the use of Open Government Data to make public data sets available to citizens to enable more informed engagement, greater social accountability of government, and opportunities to create public value by putting information into the hands of citizens. The OECD OUR Data Index assesses governments' efforts to implement open data in three critical areas – openness, usefulness and re-usability of government data.[2]

Notes
[1] OECD 2014.
[2] OECD 2015; for more on the data, see https://data.oecd.org/.

organizations seen lately in autocratic regimes, emerging democracies and democratic countries alike.

In combination with surveillance practices, such measures are creating a growing sense of limitation on citizens' freedom of speech and freedom of assembly. The Carnegie Endowment for International Peace reported that, in 2014, 50 countries placed restrictions on overseas funding for NGOs.[13] The Committee to Protect Journalists has recorded a disturbing number of restrictions of press freedom in many countries.[14] The combination of large commercial interests and weak governance can give rise to businesses being perceived as complicit in government repression of civil society – a perception fuelled by action against organizations and activists protesting against the activities of such large industries as construction, extractives or agribusiness.[15] In Cambodia, for example, the government has been criticized for arresting and imprisoning campaigners against widespread land grabs that see subsistence farmers evicted from the land they farm to make way for large-scale industrial farms.[16]

In many cases, the repression of citizen movements reflects a profound uncertainty among governments and businesses about how to deal with the questioning of established societal, economic and political structures. Leaders may be unsure of what policies to implement, or they may be constrained by internal challenges from implementing changes in a timely manner; either situation can result in doing nothing – a response of hoping that protests will pass.[17] However, any kind of failure to respond adequately to citizens' demands merely adds to their sense of disenfranchisement from traditional change-making methods.

As the rise of technology enables citizens to harness new connections and form communities that transcend geographical limits, a socially destabilizing vicious circle could become entrenched: growing expressions of anger are met with increasingly harsh responses by governments, which in turn further fuel citizens' feelings of disenfranchisement and discontent.

What Can Be Done? New Approaches and Risk-Resilience Strategies

A range of innovative responses by governments, businesses and civil society organizations can build resilience to the risk of social instability. Just as new technologies are playing a role in driving the risk, so can they also be used to mitigate it, minimizing the frustration of individuals and groups by creating a transparent and inclusive enabling environment with responsive forms of governance. This section presents innovative and emerging developments that can be taken by three different stakeholders: governments, businesses and civil society.

First, governments have the opportunity to re-empower citizens politically, opening up space for dialogue and participation, embracing transparency and accountability, and looking to enlist citizens as collaborators in public service.[18]

Bland "participation washing" approaches – described as the attitude of listening to requests but not actively addressing them – are not enough to truly contribute to more stable societies. Technology-based innovations could offer options to modernize public service management and delivery, as happened in the small Spanish town of Jun, which increasingly administers its municipal services and communicates with citizens through Twitter.[19] Equally importantly, the creation of a trust-based space for multistakeholder partnerships represents a building block for effectively managing risks (see Innovative Response 1) and successfully achieving good governance and inclusive development.[20] The effectiveness of such approaches depends on successfully tackling e-exclusion (see Box 3.1.2).

Second, businesses have opportunities to win trust, build resilience and minimize the risk of disruption by committing to transparency, responsibility and higher standards along their supply chains in areas such as worker rights and environmental sustainability, and by collaborating with citizens in new ways.

Under pressure to deliver more proactively and effectively on corporate social responsibility (CSR), businesses are going beyond traditional and often-criticized CSR models to look for economic opportunities in socially and environmentally conscious business models based on innovative and people-centred partnership approaches (see Innovative Response 2). An example of the recent emergence of Hybrid Value Chain (HVC) models, representing a complete shift in the way businesses and civil society interact,[21] is the Viste Tu Casa (Dress Your Home) programme in Colombia: an established tile manufacturer worked with the cofounder of a human rights organization to create employment for women and reach new clients by raising awareness of the hygiene benefits of tiling kitchens.[22] By leveraging the core assets of civil society organizations and businesses, HVC partnerships generate risk resilience and new revenue sources for businesses, improve the livelihoods of low-income populations and help to meet the basic human needs of populations with which civil society works.

Third, civil society has the opportunity to find ways to leverage new technologies and collaboration models to strengthen social fabric; improve services and shared spaces; make socio-economic frameworks more cohesive and inclusive; and improve the ways in which stakeholders interact, deliberate and act.

A source of inspiration for engaging and empowering citizens could be the "citizen science" movement, in which scientists have found ways to use digital technologies to engage citizens in scientific research activity. Popular platforms, such as Zooniverse,[23] are taking science out of labs and integrating hundreds of thousands of knowledgeable volunteers in collaborative, people-powered research. Citizen science gives participants a sense of belonging to an effort that creates positive, lasting change – it combines advancing scientific knowledge with educating citizens, raising awareness of issues, and encouraging wider participation in democratic debates about how science-related policy-making is done (see Innovative Response 3).

Conclusion

Fundamental demands are being expressed by people around the world, both as citizens and as consumers. Their hopes and expectations can potentially lead to improvements in governance and corporate systems, creating momentum to adapt new practices, norms and government policy. When other stakeholders listen, citizens can be enlisted to co-create the future they desire. That is the promise of the empowered citizen – but it is a promise that can be met only when the rate of transformation and innovation in government, business and civil society structures matches the rate of transformation in society itself.

Three Innovative Responses to Encourage Inclusive and Stable Societies

When people mobilize and social stability is threatened, resilience becomes critical. In a world facing huge challenges, it is imperative to ensure that institutions, communities and individuals are prepared and able to respond to unexpected disturbances. The relationship between citizens, governments and businesses needs to be designed to create a more inclusive and stable environment.

While recognizing that much more can be done in this space, the following pages explore three types of innovative response aimed at creating more transparent and open societies: re-empowering individuals, introducing citizen-centric business innovations and paving the way for critical grassroots activism. These responses intend to provide a source of inspiration for pioneering and original ways to promote social inclusion and ensure stable societies.

1. Innovative Finance for Social Outcomes

As governments struggle to reconcile budgetary pressures with increased social demands, innovative models of collaboration have been put in place to tackle major societal challenges.

The recent rise in impact investing and social impact bonds (SIBs) sees businesses and governments partnering to address pressing issues that prevent citizens from enjoying stable, equal and diverse societies.

The SIBs funding concept is a type of "pay for success" model where financiers invest capital in public projects, usually aimed at measurable improvements in social outcomes for at-risk individuals, with the goal of reducing government spending in the long term.[24] SIBs create a coalition of actors willing to share the investment risk to deliver projects that address social and environmental problems that might otherwise generate significant risks for companies, governments and individuals.

SIBs have been particularly useful for pioneering new approaches to persistent and costly social ills. From partnering vulnerable young people with toddlers to mentor as a way to address youth unemployment through personal empowerment to tackling homelessness by providing accommodation,[25] employment and medical support, SIBs have fundamentally shifted how social service programmes are structured, impacting both governmental authorities and non-profit organizations operating in the social sector.

Inspirational stories abound, with the £5 million Peterborough SIB in the United Kingdom in particular heralded as an example of fruitful public-private financial collaboration.[26] Launched in 2010, the United Kingdom's first SIB was designed to reduce reoffending among short-sentence male prisoners. Private investors face the upfront investment costs – and associated risks – of providing a not-for-profit organization with capital to carry out interventions. They are paid back a financial return by the government if social outcomes are improved based on some standard measurement; recently released evaluation results indicate that investors are on track to receive returns in 2016.[27] The Peterborough project – as is often the case for pilots – has gone through alternate phases of progress and hindrance, while overall being recognized as a key test for opening the way to the SIBs market to come. In November 2015, the UK government expanded its commitment to SIBs by announcing an allocation of £105 million for new SIBs aimed at enhancing financial support for locally designed schemes.[28]

Positive quantitative results for the Peterborough pilot, which generated global attention for the SIB model, affirm that private investment in critical social service programmes can be an effective way not only for a vulnerable population to receive services but also for investors to diversify their investment portfolio to make financial as well as social returns.

SIBs hold substantial potential for many developing and emerging markets around the world. In India, an empowering girls programme is currently being piloted in 200 schools.[29] In Mozambique, the malaria performance bond has been designed to increase funding for malaria interventions over 10 years and protect up to 8 million people from infection.[30] Several states in Latin America are experimenting in this area: for example, the Mexican state of Jalisco has been working on the design of a programme to move single mothers out of poverty, while Brazilian states such as Minas Gerais and Cearà are exploring SIBs to address prison reform and improve school completion rates.[31] The Israel Arab Workforce Development SIB, currently in the development stage, aims to increase employment opportunities for Arab citizens of Israel, who are expected to represent 20% of the state's population by 2020.[32]

Many private sector investors, however, still believe that SIBs entail too much risk for too little potential pay out. With this in mind, incentivized crowdfunding has been emerging as an option for the next generation of SIBs. Crowdfunding platforms such as Ethex, MicroGenius, Abundance and Trillionfund already have the technical profile and access to investors to facilitate the crowdfunding process and engage citizens in impact investing.[33]

By involving people more directly in funding social investments, this crowdfunded SIBs model has an even greater chance of revamping public service delivery structures towards more effective and responsive

approaches – citizens who invest in the initiatives gain an incentive to raise public support for them, and volunteer their time to help them succeed. Rigorous, increasingly crowdfunded SIBs could transform government, putting people in charge for the benefit of citizens and society.

2. Citizens beyond Consumers: Business Innovations for Social Change

Companies have developed many ways to give individual customers incentives to be loyal to their brands, such as reward cards or money-off coupons for repeat purchases. Many companies also see value in spending to position their brands as socially or ecologically conscious, for example by supporting community development projects.

Technology is increasingly making it possible to combine these ideas, which enables companies to provide incentives for individual customers to perform actions that benefit the community or environment. This is a way for individual businesses to profit by improving brand image and enhancing customer loyalty, while at the same time contributing to community or environmental resilience and engaging consumers in their own sustainability policies. These win-win situations lead to more accountable and transparent practices.

The apparel retailer Patagonia is an example. The company has reinforced its brand identity and image with a well-received campaign encouraging consumers to repair more frequently.[34] By trading the risk that customers might buy a bit less of their product, Patagonia is betting on gaining a bigger market share by attracting values-oriented buyers who want to shop at values-driven companies. By asking people to keep products longer, the company has made manifest its values and involved customers in the achievement (and watchdogging) of its own sustainability goals.

Similarly, the US-based Recyclebank is paving the way for environmental behaviour change. By recycling, its 4.4 million members in the United States and the United Kingdom can earn discounts from over 3,000 major consumer brands. Sensor technology on recycling containers and trucks enables the company to track how much recycling households are putting out for curb-side collection, and reward community members accordingly.[35]

Increasingly, it will be possible to move beyond education, individual actions and pledges and to use the Internet of Things to reward verified behaviours. It is possible to imagine citizens signing up to have data collected by their appliances and utility companies. These data would be shared with consumer brands prepared to offer rewards for eco-friendly behaviour such as using less water, turning the thermostat down or switching off lights in unused rooms. Sensors could be fitted to a household's cycles and cars, and rewards offered when data show that the bicycle, not the car, is being used during rush-hour periods.

For small and medium-sized enterprises, in particular, another emerging opportunity to win business by contributing to more cohesive and sustainable societies is offered by community currencies such as the Bristol Pound in Bristol, United Kingdom;[36] the TradeQoin in the Netherlands;[37] and Berkshares in Massachusetts, United States.[38] The motivation behind such currencies is typically to encourage citizens to spend locally and to reward them when they do, thereby strengthening the local economy by making it more diverse and resilient.

An estimated 250 community currencies are available at the global level, from Kenya and Brazil to Japan, with more to come.[39] For local small and medium-sized enterprises, active participation in community currencies represents an opportunity to stay relevant through changing consumer markets and to demonstrate solidarity with local authorities and citizens' organizations, which are typically the driving forces in their establishment.

Although local currencies are a less obvious fit for major consumer brands, it is possible to imagine incentives for environmentally conscious behaviour being offered to consumers in the form of local currency rather than discounts – thereby associating the brand not only with ecological issues but also with attempts to strengthen local communities.

With the growth of smart technology and social media, behaviour-change-focused business models will become more mainstream. These models represent a new approach for businesses and citizens that encourages dialogue and interaction and that strengthens a relationship based on collaboration, trust and transparency. By serving customers and engaging citizens – as individuals with specific values, ambitions and aspirations, regardless of their age, geography, education, income or social status – businesses can potentially build their brands while simultaneously creating positive social impact.

3. Novel Ways to Engage Citizens: Putting Them in Charge through Science

In recent years, "citizen science" has been gaining attention as a way to engage citizens in scientific activity, with endeavours ranging from air pollution assessments in Europe to chimpanzee counting in Tanzania. The proliferation of digital technologies has provided scientists with innovative ways to engage the wider public in science and expand resources for research. Similarly, it has provided citizens with new venues for developing online collaborative projects aimed at collecting quantitative analytical data to improve transparency and outcomes in public decision-making mechanisms.

A great many aspects of daily life are amenable to a citizen science approach because science and data impacts everything from the food we eat to the policies we try to influence. Although many of the highest-profile citizen science projects are limited to "crowdsourcing" – that is, to citizen participation in data gathering or monitoring exercises led by scientists – citizen engagement occurs on an ascending scale (see Figure 3.1.2). In recent years a number of "extreme citizen science" initiatives have emerged in which citizens take the lead in pursuing locally important goals by asking research questions, collecting and analysing data and using them to influence policy-making.[40]

Citizen science is more than just a new outlet that engages public-spirited citizens who have an existing interest in science. It is increasingly seen as a tool that could enable a more participatory democracy by empowering individuals and communities to analyse, understand and ultimately take ownership of the issues that affect them, enabling them to propose concrete and actionable solutions to decision-makers.[41] Citizen science projects have the potential to keep public authorities accountable, influence the way they spend public funding, and inform them about community priorities and needs.

"Factivism" – evidence-based activism[42] – can come in many forms. Recently, an open research investigation of the New South Wales pecuniary interests register for the 2013–2014 fiscal year has forced political figures to correct their disclosures of interests to the Australian parliament and thereby comply with current regulation, which requires the declaration of all directorships and shareholdings.[43] In Iceland, a group of enthused citizen scientists parsed a huge database of documents and sentences to investigate for bias by assessing a potential link between the way judges vote and how often they incarcerate.[44] The analysis showed that a particular judge suspected for bias with his conviction rate of 95% was instead within the statistical norm vis-à-vis all other colleagues of the Reykjavik district court. Other examples include crowd-reading of published oil contracts to promote more transparency in the extractive industries,[45] and leveraging open data by re-calculating the published accounts of municipalities to explain arcane budgets more clearly to citizens.[46]

A key citizen science initiative running in conjunction with the United Nations' Sustainable Development Goals (SDGs) is the Open Seventeen Challenge, through which citizens can pitch crowdsourcing projects to tackle SDGs via the use of open source data.[47] By unlocking the power of the grassroots efforts of citizens around the world, the challenge aims at identifying ideas and proposals to hold all stakeholders – including businesses, governments, NGOs, media and international organizations – accountable, while also delivering on the UN global goals. This initiative sets a precedent for a new way to interpret monitoring and evaluation mechanisms, by entrusting citizens to play a role in these processes while leveraging the power of hyperconnectivity.

These examples show how a citizen science model of grassroots activism can create new ways for citizens to engage, facilitate a wider range of lay participation, and enable bottom-up community participation. More and more often, fact-based debates and activities precede street action and complement conventional activism with increased general awareness and understanding of the policies and interests at stake. While recognizing the intrinsic limits of data and statistics (they can be "based on a firm foundation of wet sand"), and the need for citizens to interpret them reasonably and accurately, citizen science is pushing citizens closer to deliberation mechanisms and decision-making authorities.

Figure 3.1.2: Participatory Levels of Citizen Science

Source: Based on Haklay 2012.

Endnotes

[1] Leetaru 2014.

[2] Edelman Trust Barometer 2015.

[3] Tripathi 2015. On this point, the World Economic Forum's *Inclusive Growth and Development Report 2015* sheds light on how countries can make use of policy incentives and institutional mechanisms in order to widen social inclusion while sustaining economic growth (World Economic Forum 2015b).

[4] Fordham 2015.

[5] van Biezen 2013.

[6] Liu 2013.

[7] AFL-CIO 2015; Bradner 2015; Sinclair 2015.

[8] Bachmann, Correa, and de Zúñiga 2012; Van Laer and Van Aelst 2010.

[9] Howard 2014.

[10] Legrain 2015; The Economist 2014.

[11] CIVICUS 2015.

[12] Corera 2015.

[13] Carothers 2015.

[14] CPJ 2015.

[15] CIVICUS 2014.

[16] The Guardian 2012.

[17] OECD 2014; Wendling, Radisch, and Jacobzone 2013.

[18] ACT Alliance 2011.

[19] Kiss 2015.

[20] As global problems evolve and become intrinsically more complex to manage, the rise in the number of multistakeholder networks, such as the Global Solutions Networks (http://gsnetworks.org/), signals an important change in the way governments, businesses and societal actors organize around critical challenges.

[21] Ashoka No date.

[22] Uribe 2010.

[23] https://www.zooniverse.org/

[24] BIREG LLC 2013.

[25] Bridges Ventures 2012; UK Cabinet Office No date.

[26] Cook 2014.

[27] Social Finance 2014.

[28] UK Cabinet Office 2015.

[29] Educate Girls http://educategirls.in/

[30] Deveximpact 2013.

[31] Levey and Bloomgarden 2015.

[32] Social Finance Israel 2015.

[33] Cohen 2015.

[34] Patagonia 2015.

[35] https://www.recyclebank.com/.

[36] http://bristolpound.org/.

[37] https://tradeqoin.com/en/.

[38] http://www.berkshares.org/.

[39] Smedley 2014.

[40] European Commission 2013.

[41] Scicurious 2013.

[42] Bono 2013.

[43] Evershed, Farrell, and Guardian readers 2015.

[44] http://crowdcrafting.org/project/heradsdomar/ (in Icelandic).

[45] http://repository.openoil.net/wiki/Main_Page

[46] http://openkratio.org/ (in Spanish).

[47] http://openseventeen.org/.

[48] Easterly 2010.

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3.2 Climate Change and Risks to Food Security

The Intergovernmental Panel on Climate Change (IPCC)'s Fifth Assessment Report reaffirmed that warming in the climate system is unequivocal and that it is "extremely likely" that human influence has been the dominant cause. The climate is changing already[1] – and, as the World Bank's *Turn Down the Heat* report explains, failure to limit warming to 2°C will create a high risk of that change becoming catastrophic.[2] There is growing realization that failure to act, quickly and effectively, could reverse many of the advances of the 20th century.

Risks to Food Security: Analysis

The risk to food security is especially great because agriculture is already straining to meet a rapidly growing demand from a finite resource base. The combined impact of a rising population and growth of the middle class – wealthier people eat more cereal-intensive meat – is set to drive a demand increase of 60% by 2050.[3] Yet the global average yield growth for cereals has slowed in recent years; it already lags behind demand growth. This gap cannot be covered by an expansion of cropland because of the need to protect forests and other areas of high value for conservation and carbon sequestration. Agriculture is increasingly competing with other uses for land – such as urbanization, transport, bioenergy, forestry and mining – and so crop production is pushed towards ever more marginal soils.[4]

Yet more worrying is the fierce competition for water, the lifeblood of agriculture. Water withdrawals have increased threefold over the last 50 years, and demand is anticipated to rise by a further 40% by 2030.[5] With a shift in global production towards intensive systems that rely on groundwater resources for irrigation, along with the current growth in demand for water-intensive animal products, agriculture becomes even thirstier. At the same time, urbanization and industrialization in emerging and developing economies are also driving up demand for fresh water in energy production, mineral extraction, and domestic use, further stretching the already tight supply.[6]

Against this backdrop of tightening constraints, climate change seriously threatens food security in two ways. First, it will harm agricultural production: rising temperatures and changing rainfall patterns will slow yield gains, contributing to higher food prices and an increasingly precarious supply-demand balance that will make markets more prone to volatility. Second, it will increasingly disrupt food systems: more extreme weather will destabilize tighter markets and exacerbate volatility, imperil transport infrastructure and trigger local food crises. As a result, the risks of humanitarian emergencies, national or regional instability and mass migration will increase. In the words of a former Executive Director of the World Food Programme, "without food, people have only three options. They riot, they emigrate, or they die."[7] The security implications will be felt by developing and developed countries alike.

Climate Impacts on Agricultural Production

Climate change will slow global yield growth because higher average temperatures result in shorter growing seasons and lower yields. Shifting rainfall patterns can also reduce yields because lower rainfall reduces soil moisture or increased rainfall waterlogs soils. Climate trends are already believed to be diminishing global yields of maize and wheat.[8]

As climate change gathers pace, the negative impacts on yields will become more pronounced.[9] This is unlikely to be a steady deterioration. Yield responses to biophysical stresses are highly non-linear – once critical thresholds for temperature or water are breached, plants suffer severe damage and yields can fall precipitously. If climate change is allowed to reach a point where these biophysical thresholds are exceeded routinely, crop failure will become the norm.

A global temperature increase of 4.7°C – consistent with what might be expected by the end of the century on current emissions trajectories – would see sharp increases in the risk of critical temperatures being exceeded. The risk of failure will vary by crop and location. For example, researchers estimate that for maize in Illinois, in the Midwestern United States, the likelihood of temperature exceeding a critical threshold currently has a recurrence interval of 1 in 100 years; this would increase to a 1 in 6 year return period. For single-variety rice in Jiangsu on the eastern coast of China, the return period would increase from 1 in 100 years today to as often 1 in every 4 or 5 years.[10]

At lower levels of warming, yield losses may be offset by higher concentrations of atmospheric carbon dioxide, resulting in a beneficial CO_2 fertilization effect. However, the extent of this effect has recently been questioned.[11] Other factors associated with climate change – such as elevated tropospheric ozone,[12] as well as increased biotic stress from weeds, pests and disease – represent further downside risk to yields.[13]

Some of the most severe risks are faced by countries or regions with high levels of existing poverty and food insecurity, which are highly dependent on agriculture for livelihoods. Even at low levels of warming, the most vulnerable countries will suffer serious impacts. In Sub-Saharan Africa, for example, 1.5°C of warming globally by the 2030s could bring a 40% loss in maize cropping areas. A world warmer by 2°C would bring unprecedented heat extremes in summer across

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Figure 3.2.1: Projected Impacts on Crop Yields in a 3°C Warmer World

Source: WRI 2013.

Note: –50% change = half as productive in 2050 as in 2015; +100% change = twice as productive in 2050 as in 2015.

60–70% of South-East Asia. Warming of 4°C would likely bring increasing extremes in rainfall patterns in South Asia – up to a 30% decline in the dry season and a 30% increase during the wet season – increasing the risk of both flood and drought.[14]

As the map in Figure 3.2.1 indicates, the most severe yield impacts are not confined to poor and food-insecure countries. Agricultural productivity is also at risk in key exporting breadbasket regions such as North America, South America, the Black Sea area and Australia. The same is true for India and China – the two most populous nations on Earth, both currently committed to self-sufficiency (in practice, trade neutrality) in cereals. Should they have to abandon these policies of self-sufficiency, the consequences will be felt globally in the form of tighter international markets and higher prices. Reducing the risk of climate change to crop yields will necessarily encompass adapting agriculture to new regions (Box 3.2.1).

Several attempts have been made to model the impact of climate change on future food prices.[15] The modelled impacts vary considerably, depending on the underlying model parameters, climate scenarios, adaptation responses, and data employed. However, in the vast majority of cases the models find higher prices with climate change than without. Taking the mean of nine different models all using the IPCC "business as usual" emissions pathway finds that global crop prices will be 20% higher in 2050 than they would have been without climate change.[16] These models show that oil seed prices typically increase the most under climate change (up to 89% above a scenario with no climate change), though the largest single climate-induced price increase modelled is for coarse grains, at 118% above the 2050 baseline.[17]

Extreme Weather and Disruption of Food Systems

Some of climate change's most serious risks to food security arise from more frequent and extreme weather events such as droughts, heat waves and floods. These can trigger local food crises, disrupt trade infrastructure and have cascading systemic consequences – for example, crop failure in a major breadbasket region can precipitate international food price spikes.

Food Crises and Humanitarian Emergencies

Droughts or floods can have catastrophic localized consequences in regions where food insecurity is already high and markets do not function well. Recent history provides some tragic examples. The 2010 Pakistan floods, caused by a wetter monsoon consistent with climate change predictions, devastated croplands and led to a collapse in rural incomes and sharp deterioration in food security. One year later, a drought in East Africa – since linked to climate change[18] – triggered a regional food crisis affecting 13 million people; in war-ravaged Somalia, over a quarter of a million people died in the resulting famine.

Box 3.2.1: Adaptation and Its Limits

The adaptation of agriculture is critical to reduce the risk climate change poses to food systems. A number of strategies and technologies have emerged to increase resiliency in individual livelihoods and the systems supporting agricultural value chains. These can be exercised at the farm level through techniques such as changing the cropping calendar, breeding plants that have increased tolerance to extreme conditions, or shifting crop production to new regions – however, such approaches are not without their challenges. Plant breeding takes time and is ultimately subject to biophysical limits that exhibit little genetic variation within or across crops; it is hard to selectively breed for tolerance to extremes. In addition, the limited availability of suitable land means crop production cannot always migrate as desired (for example, the poor quality of soils to the north of Russia's wheat crop means production cannot simply track northwards as temperatures rise).

Therefore adaptation is also critical at the landscape level through economically viable strategies that protect biodiversity and enhance land and forest management. Market systems have a critical role to play too, especially through products such as index-based weather insurance or information systems. Finally, enabling policies for the careful management and use of food reserves, early warning systems, open trade arrangements and price stabilization can help address volatility in the system.

Distribution and Transport Infrastructure

Extreme weather events pose a risk not only to the production of crops but also to the distribution of globally traded supply. Critical transport infrastructure in many of the world's largest cereal exporters is increasingly at risk of disruption from acute and chronic climate stresses.[19]

In July 2012, for example, Russia's Black Sea ports were struck by flash floods, damaging key grain export infrastructure and interrupting trade in a year when drought had already brought a 25% drop in production.[20] In the United States, the ageing network of locks and dams along the Mississippi River – a key artery for wheat, maize and soybean exports – has struggled to cope with rainfall extremes: in 2011, flooding led to delays in barge traffic and rerouting of freight via road and rail; the following year a severe drought saw water levels fall to levels that were almost unnavigable.[21] More frequent heatwaves and floods are also exerting increasing stress on the country's railways and roads.[22] If sea levels rise by 4 feet by 2100 as projected in recent climate models,[23] around two-thirds of port facilities along the US Gulf Coast – out of which 20% of the world's maize and soy exports are shipped[24] – will be at risk of water damage or inundation.[25]

Damage to port infrastructure following an extreme climate event further exacerbates disaster situations, hindering the delivery of critical food supplies to affected populations and limiting the rate of economic recovery in the longer term. When Cyclone Pam hit Vanuatu in March 2015, maritime services to the islands were interrupted for 10 days and 80% of the country's roads were blocked by debris.[26]

Preparedness for disruption to transport infrastructure along food supply chains is often low. Climate proofing transport infrastructure brings higher maintenance costs while diverting investment away from the expansion of network capacity.[27] Yet as competition for capacity heightens, and just-in-time business models favour cost-efficiency over system redundancies,[28] the potential impact of climate events on transport infrastructure will rise, signalling an ever more severe risk to food security in import-dependent regions.

Systemic Crises

Although developed economies may be largely untroubled by food price spikes, they are vulnerable to knock-on effects – such as instability and migration – arising from the impacts of price spikes in less resilient countries.

Recent years have witnessed a series of spikes in international cereal market prices triggered by extreme weather since linked to climate change – most notably the 2010 Russian heatwave and 2012 US Midwest drought.[29] Price rises can be amplified if governments prioritize domestic food security at the expense of global food security by panic-buying, hoarding and unilateral export controls. In 2008, international cereal markets reached a crisis point when 40 governments imposed export restrictions on their agriculture sectors in a vicious circle of collapsing confidence and escalating prices.[30] Global governance was found wanting: while trade rules exist to limit restrictions on imports, there is nothing comparable to prevent limits on exports.

Once again, the poorest countries are most at risk. The 2008 crisis meant 33 net food-importing developing countries saw an increase in their total food import bill of 0.8% of GDP, contributing to deteriorations in the balance of payments and inflation.[31] Because of a high reliance on unprocessed staples, the poorest households are particularly exposed to rises in primary commodity prices. The World Bank estimates that the 2008 crisis put 100 million more people into poverty globally.[32] Among these households, food expenditures may account for more than half of income, leaving families in a very difficult situation if prices spike.

High food prices in turn increase the risk of riots and instability, particularly in countries that are politically fragile.[33] During the 2008 food crisis, protests erupted in 61 countries and riots in 23.[34] Such events can lead to cascading risks that move rapidly through markets and polities with near- and long-term consequences. The spike in international wheat prices after the 2010 Russian heatwave was felt keenly in North Africa – the largest

Box 3.2.2: Reducing Food Waste

Current estimates suggest around one-third of all food produced for human consumption is lost or wasted along the food value chain, with a direct economic cost of US$750 billion per year. Excluding land-use change, the annual emissions footprint of food produced but not consumed is around 3.3 million tonnes of carbon dioxide equivalent (CO2e), more than the total national emissions of India; the land requirement is almost 1.4 billion hectares, close to 30% of the world's agricultural land area; and the blue water (surface and groundwater) consumption is approximately 250 cubic kilometres, three times the volume of Lake Geneva.[1]

Approximately half of this volume (54%) is lost in upstream processes including agricultural production (a third of the total alone) and post-harvest handling and storage; the other half (46%) is wasted in downstream activities such as processing, distribution, and consumption. Consumption wastage is much higher in high- and middle-income regions (31–39% of total losses) than in low-income regions (4–16%). Significant low-income losses at the post-harvest stage result from a lack of adequate infrastructure to prevent spoiling.[2]

Compounding the problem of direct losses are wasteful, or resource-inefficient, forms of food production: grain-fed livestock production, for example, results in significant losses of edible calories along the food chain from those available from plants to those ultimately consumed by humans. This inefficiency is expected to become increasingly significant as a growing global middle class consumes more meat.

The cost of food wastage is significant not only in economic terms, but also for current and future resource and food security. Addressing food wastage offers significant potential to alleviate pressures on natural resources and the tightening balance of supply and demand: it is estimated that halving the current rate of wastage could meet over a fifth of caloric needs by 2050,[3] reducing required cropland by 14% and agricultural greenhouse gas emissions by 22–28% (saving approximately 4.5 GtCO2e per year) relative to the counterfactual of no reduction in food wastage.[4]

Currently the environmental costs of food waste are externalized and the market incentives to reduce waste are minimal. Maintaining supply chains that deliver year-round uninterrupted supplies of produce are inherently wasteful because retailers depend on over-ordering and suppliers on over-producing. But currently the economic benefits of this model outweigh the costs. Exacting retail quality and presentation standards, consumer expectations, and legislation governing food re-use all exacerbate the problem by rejecting perfectly edible but non-aesthetically pleasing produce. Minimizing waste will therefore require technical innovations, legislative reform, and a recalibration of consumer expectations.[5]

Notes
[1] FAO 2013.
[2] FAO 2013.
[3] Lipinski et al. 2013.
[4] Bajželj et al. 2014.
[5] FAO 2014.

wheat-importing region in the world – where the price of bread was the subject of initial protests that became the 2011 Arab Spring.

In the same year, a prolonged drought in Syria – since linked to climate change – contributed to rural-urban migration that heightened tensions in the nation's cities before conflict erupted, leading to a civil war that remains in progress.[35] The long-term consequences of the sequence of events, beginning with extreme weather and ending with the Arab Spring and Syrian civil war, are still playing out through ongoing conflict, mass migration and increased risk of terrorism.

Droughts, floods and heatwaves will become increasingly severe as climate change accelerates. Extreme El Niño events, which can wreak havoc with harvests in breadbaskets and food insecure regions alike, are expected to become more common.[36] The risk of production shocks with systemic consequences is increasing, with profound implications for the stability of international markets: one recent study found that what would have been a 1-in-100 year global production shock over the second half of the 20th century may have become a 1-in-30 year event by 2050 – a more than threefold increase in risk.[37] A double breadbasket failure, in which two critical harvests are lost, now represents a plausible worst-case scenario that could precipitate a systemic crisis of unprecedented magnitude.[38]

Conclusions

Climate change presents a profound threat to food security because biophysical stresses mean it will become increasingly difficult for agriculture to meet demand, and more extreme weather increases the risk of both local and systemic food crises. The poorest countries are most vulnerable, but crop failures in systemically important production regions will have global consequences that may extend beyond food systems.

Trade will be critical to managing short-term production shortfalls and matching long-term changes in supply and demand as the impacts of climate change on production accelerate and demand for food increases in developing countries. However, as markets become increasingly vulnerable to destabilizing production shocks in breadbasket regions, they will become a source of risk as well as a means of managing risk.

Adaptation of agriculture is a priority for both public and private sectors, but it is not a panacea (see Box 3.2.1). Agriculture is only one part of the global food system. Transport infrastructure must also be climate-proofed. System resilience requires new rules to militate against export controls and may necessitate efficiency trade-offs such as increased strategic storage.

More fundamentally, there are limits to what agricultural adaptation can achieve and significant uncertainty about where, and when, these limits will be reached. The longer climate change continues, the more likely it is that these limits will be found. According to the IPCC, "there may be a threshold of global warming beyond which current agricultural practices can no longer support large human civilizations."[39] Without ambitious, determined action to reduce emissions and contain climate change at manageable levels, long-term food security cannot be guaranteed.

Spheres of Action to Mitigate the Climate Risk on Food Security

This section addresses three spheres in which action can be taken. These include the use of big data to boost the efficiency and specificity of climate-risk information; the provision of insurance innovations that can reduce risk to small farmers, who are an essential and fundamental aspect of agricultural success; and the incentivization of climate-resilient, low-carbon investments.

1. Big Data and Improved Climate-Risk Information Services

Timely, accessible and actionable climate and weather information enables farmers, communities and local authorities to identify their specific vulnerabilities to climate variability and to develop response strategies. This information is also key to any design of the kind of efficient and effective insurance schemes further explored below, which could help reduce exposure to economic losses.

Tailored information is critical, given the complexity and geographic specificity of climate change impacts. One example is high-resolution topographic data, which will be made available by the US Geological Survey following a White House announcement last September. The data, generated from NASA's Shuttle Radar Topography Mission (SRTM) in 2000, previously covered only the United States; it is now also available for Africa, and next year will expand to include Latin America and the Caribbean. This kind of topographic data could greatly enhance agricultural planning for drought, glacial retreat, inland flooding, landslides and coastal storm surges.[40]

However, enhanced information alone is not enough. Equally essential is the capability to model potential impacts on interconnected environmental, social and economic systems if vulnerable communities are to develop the better capacities and integrated policies needed for long-term resilience. It is challenging, however, to develop actionable information from a large range of data gathered from different sources. Data are mostly insufficient to meet the information needs for evidence-based climate adaptation, especially in vulnerable developing regions that have large agricultural sectors exposed to increased climate risk.

Consequently, attention is increasingly turning towards broad-based partnerships that bring together information services, policy resources, technological and modelling skills and capacity building and training. Many of these partnerships cut across public and private sectors to leverage increased data analysis and modelling capabilities. For example:

- For many least-developed countries and small island developing states, improved early-warning systems for natural disasters are a key enabler of sustained and climate-resilient growth and development. Responding to that need, the government of France proposed at the Third UN World Conference on Disaster Risk Reduction in March 2015 in Sendai, Japan, to mobilize the international community to improve the climate resiliency of vulnerable countries, namely Small Island Development States and Least Developed Countries. During the COP21 meetings in Paris, the Climate Risk Early Warning Systems (CREWS) initiative was officially launched by the governments of Australia, Canada, France, Germany, Luxembourg and the Netherlands. Collectively, the six countries pledged over US$80 million to scale up improved climate-risk early warning systems across 80 countries.

- **UN Pulse** is the response to a call from the United Nations' High-Level Panel on the Post-2015 Development Agenda for data to "improve accountability and decision-making, and to meet the challenges of measuring sustainable development progress."[41] Labs in New York, Jakarta and Kampala are bringing together government, UN agencies, academia and the private sector to pioneer new approaches to using big data for development.

- The **Climate Services for Resilient Development Partnership** was launched by the United States during the Climate Summit in partnership with the United Kingdom, the Asian Development Bank, the Inter-American Development Bank, Google, the Skoll Global Threats Fund, the American Red Cross, and the GIS software company Environmental Systems Research Institute (ESRI).

- The World Resources Institute developed **Global Forest Watch** is an online system to monitor forests and provide information to improve their management (see http://www.globalforestwatch.org/about/awards_and_testimonials). It combines satellite data with modern mapping and information and communication technologies to enable a new kind of environmental monitoring and decision-support tools.

- A partnership between Google and the Brazilian environmental NGO Imazon, **Google Earth Engine** integrates satellite measurements dating back decades with other data feeds such as weather information to map changes such as deforestation in remote areas. Future applications will enable monitoring of sea ice change and illegal fishing.

- IBM's **Insight Cloud Service**, a partnership with Twitter and the Weather Company, combines open data with private data to produce analytics enabling, for example, insurance companies to issue weather warnings to policy-holders.

Such programmes illustrate how large-scale collaborative efforts that leverage large data sets, scientific modelling, computational power and capacity-building programmes can improve local decision-making to increase resilience and reduce exposure to important food security-related risks.

2. Reducing Economic Exposure through Insurance Innovations

Crop insurance schemes do not always deliver sufficient protection for small farmers against potential losses – either because they are too expensive for low-income smallholder farmers or because they provide perverse incentives that discourage policy-holders from investing in crop productivity. International aid for disaster relief financing has often proved to be slow, ad hoc and expensive. Innovative climate-informed insurance schemes can help to address the shortcomings in these two models, efficiently reducing exposure to economic losses and thereby food insecurity.

Robust and affordable weather insurance depends on the availability of accurate data, together with improved capabilities to forecast weather variability and extreme events such as droughts. Today a combination of data provided by weather stations with remote sensing and satellite imagery are helping scale innovative insurance schemes across developing countries.

Weather index insurance schemes, also known as "index-based financial risk-transfer mechanisms", pay out based on weather rather than crop losses. They use an index of productivity-relevant weather variables such as precipitation onset and intensity, streamflow and temperature: the insurance pays out, for example, if measured rainfall falls below a specified level.

One advantage of weather index insurance is that it removes the need for expensive field visits to assess crop damage, reducing costs and improving accessibility of insurance for low-income smallholder farmers. Having such insurance coverage can create a virtuous circle: it often is a necessary condition for accessing bank loans or other credit, which in turn can be used to invest in improved agricultural inputs for increased productivity and reduced risk exposure. Weather index insurance schemes also remove the possibility of poorly designed crop failure insurance schemes that effectively incentivize farmers to allow crops to fail.

With nearly two-thirds of its population working in agriculture – 80% as smallholder farmers – Sub-Saharan Africa is especially vulnerable to food insecurity caused by droughts and temperature rises. World Bank data suggest that Sub-Saharan countries will need between US$14 billion and US$17 billion per year from 2010 to 2050 to adapt to climate change.[42] The **Africa Risk Capacity (ARC)** is an innovative African Union initiative, launched in 2014, to help close the financing gap by improving insurance for climate-related risks.

ARC combines several risk transfer mechanisms to reduce the cost of insurance while increasing its effectiveness. For example, because not all parts of the continent will be affected by drought at the same time, by pooling drought risk across all member countries ARC can reduce individual premiums paid by governments by up to 50%. To be eligible for insurance through ARC, governments have to develop evidence-based contingency plans.

In addition to regular ARC insurance schemes covering the costs for immediate responses to weather disasters, the ARC Extreme Climate Facility will issue data-based climate change catastrophe risk bonds to participating countries.[43] These bonds are structured as concessional finance that must be used to reduce risk exposure and vulnerability. This not only provides countries with incentives to invest in climate-smart agriculture, but also improves long-term planning and reduces investment risks for the private sector. By blending public and private finance, ARC hopes to generate over US$1 billion in additional finance over the next 30 years.

3. Financial System Shift to Unleash Climate-Resilient, Low-Carbon Investments

Effectively tackling climate-induced risks will require new ways to incentivize climate-smart investment. Despite increasing recognition of the economic risks, global financial systems are yet to incorporate them into financial decision-making. Finding ways to adapt established risk assessment analytics, models and reporting frameworks could unleash larger flows of capital towards climate-friendlier investments.

For many executives and boards of directors, climate risks seem less immediate than other issues. Even where Environment, Social and Corporate Governance (ESG) data are disclosed, investors often remain unaware of the severity of the threat: these data tend to be appended in an annex rather than integrated into core financial statements, and they do not make clear the materiality of specific climate and regulatory risks. The sheer number of ESG criteria is a barrier to comparability and identification of

material risk. Most analysts do not take opportunities such as earnings calls to raise questions on material climate risk.

Finding ways to factor climate and regulatory risks into short-term decision-making processes and related financial metrics is essential for driving climate risk–informed investments. This requires not only using better, forward-looking data and metrics, but also mainstreaming these elements in core financial processes and indicators. One major step in that direction is the recent announcement of Mark Carney, the Governor of the Bank of England and Chair of the G20's Financial Stability Board (FSB), for the FSB to support global efforts for voluntary standardized reporting on financial risks associated with climate change.

Corporate commitments and domestic regulatory reform can also be important drivers of change. At the COP21 in Paris a number of new corporate commitments to decarbonize portfolios, issue green bonds, or support more robust carbon pricing were made. They send important signals to the broader business and investment communities and help to win the trust of governments in corporate support for improved climate-friendly regulations. China's Green Credit Policy, launched in 2007, is an example of how regulators can tip markets towards more sustainable investment.

Understanding how regulatory reform across sectors can help align financial markets with sustainable development is the objective of the United Nations Environment Programme's **Inquiry into the Design of a Sustainable Financial System**. Other recently launched initiatives seek to align various aspects of the financial markets with climate-associated financial risk and sustainable development:

- The **AR!SE Initiative** (Private Sector Alliance for Disaster Resilient Societies), a global effort led by the United Nations Office for Disaster Risk Reduction (UNISDR), aims to provide a new vehicle for collaboration between the private and public sectors that can unlock enormous potential at the local, national, regional and global levels to contribute to achieving the outcome, goals and targets of the Sendai Framework for Disaster Risk Reduction 2015–2030.[44] By engaging and expanding the number of private sector organizations and others involved in supporting the implementation of the Sendai Framework for Disaster, AR!SE will provide a robust and effective mechanism to allow the private sector to implement tangible projects and initiatives that deliver results critical to the achievement of the outcome and goal of the Sendai Framework.[45]

- The **Investor Confidence Project**, led by the Environmental Defense Fund, seeks to create a marketplace for energy efficiency by standardizing energy efficiency protocols. Standards are an important enabler for growing investments in emerging industries because they provide the transparency, comparability and security required by underwriters and investors. Retrofitting buildings to be more energy efficient is one example where lack of standardization is a barrier to scaling up investment, despite the clear economic benefits.

- The **Banking Environment Initiative** (comprising Barclays, BNP Parisbas, BNY Mellon, Deutsche Bank, Goldman Sachs, Lloyds Banking Group, Northern Trust, The Royal Bank of Scotland (RBS), Santander, SMBC, Standard Chartered, Westpac) has led the development of new trade finance instruments, such as Sustainable Shipment Letter of Credits, intended to incentivize sustainable land use and to preserve forests when working in developing tropical nations.

- The **1-in-100 Initiative** seeks to stimulate and reward climate-resilient investment through collaboration involving insurance companies, regulators, scientists, modellers, accounting professionals, investors and other stakeholders. The initiative focuses on adapting lessons from the insurance industry about how regulatory reform for capital requirements and accounting procedures can be applied to other economic sectors to increase the resilience of balance sheets to climate shocks, while increasing the transparency of a company's exposure to climate risk.

Endnotes

[1] IPCC 2015.

[2] World Bank 2013.

[3] Alexandratos and Bruinsma 2012.

[4] Lee et al. 2012, pp 46 and 109.

[5] 2030 Water Resources Group.2009. See also World Water Assessment Programme 2009.

[6] Lee et al. 2012.

[7] Rizzo 2009.

[8] Lobell and Gourdji 2012.

[9] Porter et al. 2014.

[10] Sanchez, Rasmussen, and Porter 2014.

[11] See, for example, Feng et al. 2015; Myers et al. 2014; O'Leary et al. 2015.

[12] Porter et al. 2014.

[13] King et al. 2015; Pautasso et al. 2012; Porter, Montesino, and Semenov 2015.

[14] World Bank 2013.

[15] See, for example, Nelson et al. 2010; Willenbockel 2011.

[16] The business-as-usual pathway is the Representative Concentration Pathway (RPC) 8.5. RPCs describe greenhouse gas concentration trajectories adopted by the IPCC for its fifth Assessment Report in 2014. See Nelson et al. 2013.

[17] Nelson et al. 2014.

[18] Lott, Christidis, and Stott 2013.

[19] Bailey, Wellesley, and Preston (forthcoming).

[20] Bailey, Wellesley, and Preston (forthcoming).

[21] Gordon et al. 2015.

[22] Schwartz et al. 2014.

[23] Walsh et al. 2014.

[24] Bailey, Wellesley, and Preston (forthcoming).

[25] US Department of Transportation 2011.

[26] Vanuatu, Government of 2015.

[27] Sims et al. 2014.

[28] Lee et al. 2012.

[29] Porter et al. 2014.

[30] Mittal 2009.

[31] IMF 2008.

[32] World Bank 2008.

[33] Natalini, Jones, and Bravo 2015.

[34] von Braun 2008.

[35] Kelley et al. 2015.

[36] Cai et al. 2014.

[37] Bailey et al. 2015.

[38] Bailey et al. 2015.

[39] IPCC 2014.

[40] NASA 2014.

[41] United Nations Global Pulse 2015.

[42] Tuttle 2014.

[43] Tuttle 2014.

[44] UNISDR 2015.

[45] UNISDR 2015.

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3.3 Global Disease Outbreaks

Risk of Infectious Disease Outbreaks: Analysis

The recent Ebola crisis will not be the last serious epidemic the world faces; indeed, public health outbreaks are likely to become ever more complex and challenging. Despite progress in some aspects of public health over the past two decades, endemic infectious diseases remain a major problem, and new or resurging infections, the spread of drug resistance and the rise in non-communicable diseases all pose enormous challenges to often fragile health systems.[1]

Infectious diseases, which are among the leading causes of death worldwide, do not confine themselves to national borders. Their capacity to spread rapidly across geographies – jeopardizing social and economic security as well as challenging human health and well-being – is amplified by ever-growing globalization, increased trade and travel, the rise in urbanization, and changes in the environment, behaviour and society. Some threats, such as influenza, are known. Others are not. Unknown just a few decades ago, HIV/AIDS has killed more than 30 million people from all socio-economic backgrounds. What might be the next HIV/AIDS, and are we sufficiently prepared for its arrival?

At the same time, new opportunities to predict, prevent, detect and treat diseases are emerging from a better understanding of the social determinants of health and from trends including new technologies in real-time diagnosis, data analysis (including in the field of genomics), biomedical research, the internet and mobile data and communications, often developed outside the traditional health sector. More innovative ideas, partnerships, and ways of working and financing will be critical for containing the dynamic threat of outbreaks in the 21st century.

Causes for Concern

By 2050, the world's population will have risen to 9.7 billion.[2] Cities will become increasingly dense and shanty towns – with inadequate housing and a lack of basic services such as water, sewerage and waste management – will swell. A combination of high population density, poverty, changes in social structures, and a lack of public health infrastructure will create progressively more favourable conditions for communicable diseases.

Meanwhile the increasing transnational flow of commodities, people and animals coupled with increased spatial density will magnify the transmission of these diseases, both between people and across the human-animal barrier.[3] Most large cities have airports through which millions of passengers travel: over 2 billion global passengers travelled annually by air in the first decade of the 21st century, compared with just 68.5 million in the 1950s.[4] Continued growth in the movement of people and commodities between urban centres intensifies the risk of infectious transmissions across geographies and diminishes the ability to respond to, and effectively prepare for, a global disease outbreak.

A recent study led by the University of Cambridge identified 20 known infectious diseases that have re-emerged or spread geographically, including dengue, chikungunya, typhoid, West Nile, artemisinin-resistant malaria and the plague.[5] Other known threats – such as influenza (i.e. H1N1 Swine Flu), MERS-Cov, and Ebola – continue to raise fears, especially when they take hold in densely populated areas and when treatment and prevention measures are not necessarily available. Even when known infectious diseases can be mitigated by existing treatments or vaccines, we face the risk of emerging resistant strains, mutating viruses, or a pandemic that is so large it renders response supplies inadequate.

Advances in research and the discovery of diagnostics, drugs and vaccines have saved millions of lives, but these gains remain very fragile and are under threat from the growing resistance of microorganisms to the most effective known medicines. The number of deaths in the European Union and the United States as a direct result of antibiotic-resistant bacteria is increasing every year, and the burden in low- and middle-income countries is much higher.[6] The emergence and spread of strains of HIV, tuberculosis and malaria that have evolved resistance to current medicines are of particular concern, as they could overturn much of the progress made against these diseases in recent years. An independent review, funded by the Wellcome Trust and the UK government, estimates that by 2050, if no action is taken, these drug-resistant strains could cost an additional 10 million lives each year and around US$100 trillion in lost output; approximately the equivalent of losing the UK economy from global output every year.[7]

Infectious diseases that are not currently on the radar are also a cause for concern. The greatest potential threats among unknown pathogens are those that spread easily – through the air, for instance – and to which humans have little or no immunity. The 2002–2003 SARS pandemic provides one recent case study: ultimately governments, businesses and people came together to overcome the outbreak, although not before it had caused nearly 8,000 infections and 800 deaths across 29 countries.[8] The death toll would have been much higher had the virus been more easily spread: infectious disease experts believe that if SARS had been more contagious, it could have become one of the worst pandemics since the 1918 influenza outbreak that killed 50 million people.[9]

The SARS crisis demonstrates the socially destabilizing potential of unfamiliar new diseases. As affected

Part 3.3 was contributed by Jeremy Farrar, The Wellcome Trust, Stéphanie Cristin, World Economic Forum and Priya Basu, The World Bank.

areas came to a standstill, in cities such as Beijing, Singapore and Toronto people stayed home, public places emptied and health workers were shunned.[10] Next time an unfamiliar disease causes panic, there is no guarantee that it will occur in a geography where effective solutions can be initiated as quickly as in this instance. Furthermore, the risk posed by the immediate effects of outbreaks must not minimize the long-lasting effects on society as a whole. The recent Ebola crisis in West Africa points to the intensified nature of the risk and its heightened complexity in places where health systems are vulnerable and lack diagnostic or response measures. Over the course of the crisis, more than 11,000 people died and more than 16,000 children were orphaned.[11] Basic health services such as prenatal consultations, routine vaccinations, antiretroviral therapies and treatment of endemic diseases in the region were sharply reduced. As stigma rose, schools closed while growing distrust and fear shifted community interactions. The hours of schooling lost, the reconfiguration of families, and decreased food security and employment, to name only a few of the epidemic's effects, will impact the affected region well beyond the halt of the outbreak.[12]

Economic Risks

Beyond direct effects on health, infectious diseases impose significant economic costs. Adding to the direct costs borne by sufferers and their households, infectious diseases – particularly those that are relatively fast-spreading or poorly understood by the general population – have an additional economic impact through a response called "aversion behaviour". This was demonstrated when Singapore came to an economic standstill over SARS, as well as in responses to Ebola in 2014 and HIV/AIDS in the early 1980s.

Aversion behaviour includes actions taken by individuals to avoid any exposure to the illness, as well as actions taken by investors as they anticipate those individual decisions.[13] Even individuals who have no direct contact with the disease will take a range of actions to avoid any risk of contracting the disease. As shown by the recent Ebola outbreak, these reactions can be rational or they can dramatically overestimate risk, leading to a wide variety of factors that can negatively impact the economy, from stress to labour and supply scarcity, financial market instability, and price increases.

The economic impact of aversion behaviour may be significantly greater than the direct economic impact from sickness and death. In the Ebola crisis, the loss of life in Guinea, Liberia, and Sierra Leone was accompanied by the closure of businesses, dramatic reductions in travel and tourism, and trade slowing to a trickle. At the beginning of 2014, expected economic growth for the year was 5.9% in Liberia, 11.3% in Sierra Leone and 4.5% in Guinea. By the end of the year, actual growth was only 2.2% in Liberia and 4.0% in Sierra Leone, while in Guinea the economy shrank.[14] In Liberia, more than 70% of households reported having insufficient money to buy food.[15] The adverse impacts were not restricted to countries that experienced cases of Ebola: Burkina Faso, Côte d'Ivoire and the Gambia all experienced adverse impacts on GDP.[16] For 2015, the World Bank estimated a potential loss in GDP of more than US$1.6 billion in the three most affected countries, and more than US$500 million across the rest of the continent.

Any fears about an inability to contain a major epidemic will have economic effects outside the affected areas because of the increasingly interconnected nature of the global economy. The economic impact of the Ebola epidemic could have been much worse: at its height, the most pessimistic epidemiological projections of how the disease could spread, combined with economic modelling, suggested a potential impact of tens of billions of dollars in West Africa alone.[17] During the SARS outbreak in 2003, estimates of the potential impact ranged from US$30 billion to US$100 billion. In the case of SARS, too, the actual impact was likely lower because the epidemic was contained – but the economic damage was still significant.[18]

Challenges in Containing the Risks

To know where to channel resources most effectively, stakeholders face the challenges of preparing for and responding to known threats and anticipating the source of new ones. The lack of adequate, resilient public health surveillance systems, infrastructure to effectively deploy resources and a health workforce to provide accessible, quality care where needed leaves us vulnerable to regional and global spread. Many emerging infections and antibiotic-resistant strains of common diseases originate in one location and then disseminate to new places at often alarming speeds: societies are only as strong as the most fragile health system (see Initiative 1).

Preparedness and response measures must therefore address three key areas: behaviour; diagnostic, drug and vaccine research and development (R&D); and regulatory and financial environments.

Behaviour
The multifactorial nature of broader global health issues poses an enormous challenge to all stakeholders – governments, non-governmental organizations (NGOs), industry and citizens. Changing demographics, climate change, urbanization, travel, political instability, war and terrorism are only a few of the factors challenging our preparedness for and response to endemic and emerging infections and the spread of non-communicable diseases.

There is an urgent need for society to value and invest more in evidence-informed public health strategies. Despite major advances in the global economy over the past 50 years, millions of people worldwide still cannot access basic needs, such as improved tap water and toilets.

Even with political interventions to provide the necessary infrastructure, halting the spread of infectious diseases will require addressing individual and collective human behaviours. Proper prevention and responsible, fact-based crisis communication, including educational campaigns and behaviour change strategies to facilitate the long-term adoption of health-

Box 3.3.1: Health Communication

Health communication often receives less attention and fewer resources than medical, scientific or policy areas. However, failure to convey the right information risks costly consequences at the individual and societal levels. In a crisis situation, panic can spread quickly and the way communication is handled can either cost or save lives. Models that combine thinking from theories of complex systems, crowd dynamics, group psychology and information are being used to assess the impact and effectiveness of mass communication in the event of a major health outbreak.

Prevention is another area in which communication must be handled with care. For decades, governing bodies have considered that simply providing the most accurate information to people was the best way to improve public health prevention. However, evidence for this approach has not been encouraging – messages on the dangers of smoking, for example, have had relatively little effect on behaviour. As understanding grows about the circumstances in which individuals do not make rational choices, a more subtle form of prevention is getting momentum. As well as providing information, this involves "nudges" – evidence-informed strategies that, rather than forced compliance, encourage the adoption of behaviours and habits that are good for people and social groups.

The incentives employed are not necessarily monetary; they could be compliance with social norms or aversion to risk, drawing on insights from behavioural economics, psychology, anthropology and neuroscience. After the British government led the way in the late 2000s, many countries have set up behavioural insight units that have led to significant improvement in the effectiveness of public health prevention. On 15 September 2015, President Obama signed an executive order to further the use of behavioural insights in improving policy-making.

maintaining behaviours, need to be carefully designed, field-tested and implemented (see Box 3.3.1).

Understanding the social and cultural contexts that may contribute to epidemics, such as burial practices or misconceptions about how a disease is transmitted, is also critical. To increase trust in evidence-based medical interventions, it is essential to gain insight into cultural sensitivities and work in partnership with local communities.

Diagnostic, Drug and Vaccine Research and Development
It can take 20–30 years to develop a new drug or vaccine, and the costs and risks are high. R&D efforts are not coordinated to achieve their greatest impact: the current model prioritizes the development of profitable products that can generate maximum sales, usually through volume rather than benefits, instead of focusing on unmet public health priorities. There is a lack of mechanisms that incentivize and stimulate the development of novel diagnostics, drugs, and vaccines and compliance with treatments.[19]

The recent Ebola outbreak arguably illustrates the human cost of the current development model in the face of potential public health threats. Recent tests on an Ebola vaccine in Guinea seem to show that it provides remarkable and immediate protection; however, the same vaccine had been tested on monkeys a decade ago, but subsequently languished in scientific limbo (see Box 3.3.2).[20] Had resources been devoted to following through earlier, the development of a vaccine could have been accelerated, potentially saving many of the 11,000 casualties.

Regulatory and Financial Environments
Despite the progress that has been made in the last two decades, more needs to be done to create enabling regulatory environments. Development of the aforementioned Ebola vaccine, for example, could conceivably have been accelerated more quickly as the epidemic took hold, but a number of barriers hindered the ability to expedite clinical trials. Mobile data is another area where regulations on privacy need to be balanced with public health imperatives, as it has increasing potential to track the spread of epidemics (see Initiative 3).

The sluggishness of progress towards a regulatory environment specifically targeted to epidemic crisis situations is a matter of growing international concern. This work needs to be coordinated by an empowered and properly funded global health body: the World Health Organization (WHO). A collaborative framework exists – the International Health Regulations, originally created in 1969 to contain cholera, smallpox, yellow fever and the plague, and since expanded to cover more diseases – but it does not provide adequate reassurance that countries are putting in place what is needed to prepare for, and respond to, emerging crises.

Countries need to be empowered to allow a timely and robust response so they can request and expect speedy international assistance when needed. Incentives and financing mechanisms need to be generated to encourage investments in public health, and countries need to be held accountable. Platforms such as the Global Health Security Agenda and the WHO's Global Influenza Surveillance and Response System have had some success and aim to complement current regulations and mitigate threats, but they fall short of constituting a comprehensive, robust global system with the flexibility to defend against both known and unknown biological threats.

The Future of Collaboration

From logistics to communications, from financial services to pharmaceuticals, the private sector has capabilities and expertise that can be truly beneficial in a public health outbreak. To leverage them most effectively, however, requires common ground and trust-based cooperating mechanisms at local and global levels with the public and non-government sectors that have been established in advance of an emergency (see Initiative 2).

Box 3.3.2: Developing an Ebola Vaccine: Reflections on the Current Regulatory Environment

In the 38 years between the first Ebola epidemic in Zaire (now the Democratic Republic of Congo) and its December 2013 emergence in Guinea, methods for containing Ebola were standardized but few advances were made in the development of a vaccine.

By 2009, at least seven Ebola vaccines had been tested in monkeys.[1] Yet by 2014 none had been through phase I safety testing in healthy human volunteers. There were no existing study protocols for evaluating experimental vaccines or treatments in an epidemic setting, which meant that it took time to design and agree on the way forward and gain ethical approval. Even when protocols were agreed, some organizations delayed supplying their therapeutics – not from lack of enthusiasm, but because they did not have pre-agreed frameworks in place to allow them to do so. As the crisis neared its peak in August 2014, three candidate vaccines were in development with the potential to be used in clinical trials:

1. Merck (Newlink) had VSV-EBOV, originally developed in partnership with the Canadian government. Merck had preclinical data, but the vaccine had not been tested for safety in phase I human trials. Safety trials commenced only in October 2014.
2. GlaxoSmithKline (GSK) had ChAd3-ZEBOV, originally developed by Okairos, but again with no human safety data. Phase I trials began in September 2014.
3. Johnson & Johnson's phase I clinical trials began in January 2015.

Despite these delays, infectious disease experts argue that in some ways the world was relatively lucky with Ebola – vaccines had already been in development because the pathogen had been earlier identified as an infection with bioterrorism potential. This is not the case for other known diseases, such as MERS-CoV, chikungunya and West Nile, which will require a focused and coordinated R&D effort.

The current development model in vaccinology could be improved in three main ways. First, there should be leadership and coordination of clinical trial activities in epidemics by a neutral body to ensure that they are efficient and properly prioritized. As the Ebola outbreak took hold, a multitude of countries and research consortiums planned phase I and II/III clinical trials, but there was little coordination of these efforts. The WHO, working with member states, philanthropists, industry, NGOs and academia, should coordinate this priority-setting and ensure equitable access.

Second, phase I clinical trials must be conducted in the inter-epidemic period, at least for known diseases where a vaccine/treatment is feasible or already in development. We must also develop novel platforms to allow for an assessment and preparation for hitherto unknown infections. Finally, agreed trial protocols, contracts and initial ethics approvals for phase II/III studies should be drawn up so that, when an outbreak begins, trials can start within days or weeks, not in months.

Note
[1] Plotkin, Mahmoud, and Farrar 2015.

There is a long history of public-private cooperation in response to infectious diseases. The Medicine for Malaria Venture (MMV) and the Global Alliance for Vaccine Initiative (GAVI), for instance, are long-standing examples of cross-sector partnership that came out of a projected public health disaster that was the result of escalating antimalarial drug resistance in the late 1990s and the need for greater equitable access to vaccines.

Despite these and similar advances, new collaborative approaches are needed as the danger of outbreaks grows. Such approaches could explore:

- Ways to harness the data being generated by businesses in a range of sectors to strengthen predictive models and improve early detection and monitoring of epidemics;
- Ways to drive forward the research agenda by pairing private vaccine, drug and diagnostic researchers with public health experts and policy-makers;
- Ways to improve regulatory frameworks and policies across nations;
- Ways to provide stable and flexible long-term financing to deliver the necessary interventions;
- Ways to optimize in-country operators in source regions who can provide on-the-ground capabilities for building stronger health systems and early-stage logistical support in a crisis, and who can undertake emergency response measures; and
- Ways to promote responsible media engagement as part of crisis management communications, with the identification of trusted sources of information and the dissemination of messages targeted to the right audience, using the most appropriate local or global information channels.

Box 3.3.3: The Pandemic Emergency Financing Facility (PEF)

The world's Ebola response has highlighted the need for new financing mechanisms that can quickly deploy emergency funding and rapid response teams at the first sign of a crisis.

The World Bank Group is working with the WHO and other partners, including Munich Re and Swiss Re, on one part of the solution: the Pandemic Emergency Financing Facility (PEF). The PEF would respond to the G20 Brisbane Leaders Statement on Ebola, and it received the endorsement of G7 leaders in Germany in June 2015. Its open platform structure will be able to function effectively within the evolving global pandemic financing architecture.

Simply put, the PEF would purchase private sector insurance coverage for developing countries to cover the immediate costs of crisis response. It would deliver financing swiftly to governments and international partners, once a pre-agreed parametric trigger is invoked. The payouts to the affected countries would come from the bond markets and (re)insurance companies. In both cases the insurance premium would need funding from donors, although potential beneficiaries could also contribute. Over time, the PEF would grow in terms of size, geography and events covered, as the market for pandemic risk insurance in developing countries grows. Governments have already used this model to successfully manage climate and natural disaster risks.

Preventing future infectious disease outbreaks from becoming human and economic tragedies requires action on several fronts. First, countries must invest in better preparedness, which starts with focusing on core public health functions and strengthening health systems. Second, there is a need for a smarter, better-coordinated global epidemic preparedness and response system that draws on the expertise of many more players; in this context, more effective public-private partnerships are critical, particularly around logistics and communications. Third, a better-resourced and empowered WHO that is equipped to work with countries in monitoring outbreaks, identifying potential threats and mobilizing on-the-ground support is an imperative.

Because assessing insurance premiums creates incentives to quantify the risks, a financing mechanism such as the PEF could help on all the above fronts. It could create two important differences the next time there is a potential pandemic:

- Financing would be available quickly (within days) from the PEF, bringing discipline and rigour to the whole system because a response strategy is thought out pre-emptively.
- The PEF's design and in-built contingencies would drive the various concerned national and international players to work together more effectively and coherently in advance, thus ensuring the appropriate highest level of crisis preparedness and response readiness.

New predictive models, financing mechanisms and leadership for the preparedness and response of future outbreaks and antimicrobial threats are key to reducing the risks we face in the short, medium and long term.

The Ebola response was financed by contributions from a range of non-governmental organizations, notably Médecins Sans Frontières, philanthropy (the Bill & Melinda Gates Foundation, the Paul G. Allen Family Foundation, the Skoll Foundation, and the Wellcome Trust), governments, social sector organizations, private sector companies and individuals. However, new models are needed if future response is to be faster, more stable, flexible and long term. To enable such models, the private and public sectors must jointly develop new financing options, such as draw-down facilities, insurance programmes and bonds.

The World Bank Group, in collaboration with the WHO and private sector players, including Swiss Re and Munich Re, is developing an insurance product that will provide early financing to affected countries to respond to future epidemics (see Box 3.3.3). Such initiatives and incentives could be linked with the willingness of governments to invest sustainably and in a verifiable way in critical public health infrastructure.

Conclusion

The Ebola crisis has put the spotlight on the importance of reducing the vulnerability of societies to infectious disease threats. As public health becomes ever more complex and our interdependency grows, it is clear that new equitable approaches, technologies and innovative community and business models, and response strategies and financing mechanisms will increasingly be needed to contain known and unknown threats that endanger social and economic stability worldwide. There must also be better mechanisms in place to manage risks through international cooperation, involving both the public and private sectors beyond the traditional healthcare industry.

Three Initiatives to Mitigate the Risk and Impact of Global Disease Outbreaks

1. Building Resilient Health Systems

As highlighted most recently by the Ebola crisis, a single and localized outbreak can put national and even international health systems at risk if they are unprepared to react quickly. The world will remain vulnerable to public health emergencies until every state has comprehensive primary care services, an adequate number of healthcare workers, available medicines, robust health information systems, infrastructure, public financing and a strong government to deliver equitable and high-quality services to all its citizens.

During and in the aftermath of an outbreak, health systems become more vulnerable to new crises. For example, in November 2014 fewer than half of the health facilities in Liberia were seeing patients; the government estimates that from May to August 2014, skilled birth attendance was 27% below 2013 levels, measles immunization was down 50% and overall health services were operating at 40% lower capacity. Even in areas where essential health services have begun to resume, the loss of these services during the height of the epidemic continues to have an impact.[21]

During the United Nations Development Programme (UNDP)'s International Ebola Recovery Conference in July 2015, the international community pledged funds to build robust health systems to "get to zero and stay at zero" in the Ebola-affected countries. However, it took a global health threat and close to 11,000 deaths to create this momentum.

One challenge to strengthening health systems is that very few programmes address the entire system. No single innovation or player can allow an entire system to leapfrog in the way that, in the telecommunications industry for example, mobile phones made it unnecessary to establish expensive infrastructure for landlines.[22] The WHO has identified six building blocks of health systems; most strengthening interventions address only one of these blocks. Some target health worker training; others focus on demand financing and insurance schemes; still others aim to improve service delivery and access to medicines and technologies. Although all these efforts lead to meaningful improvements, their impact remains limited because they do not address all dimensions of the health system in a synchronized and synergistic way.

It is critical to understand the most efficient way for all health stakeholders to collaborate. An extensive analysis of successful innovations in emerging economies has shown that well-thought-out ecosystems of partnerships can significantly improve the impact and financial sustainability of health initiatives.

Ogun State in Nigeria, for instance, is pioneering an ecosystem of partnerships that synchronizes all projects and programmes in primary service delivery, creating a model that will increase low-income individuals' access to basic healthcare that can be replicated in other Nigerian states. The World Economic Forum supported the state's Commissioner of Health in convening private and public sector stakeholders that together defined the priorities and mapped out partners that could contribute in a synergistic way. Projects include a state-subsidized insurance scheme, work on modernizing transport and logistics, upgraded equipment, improved sourcing of basic medical products, and a community-based primary care facility model with elements of public-private partnership. The intervention is coordinated by a project management unit funded and managed by African Health Markets for Equity in partnership with governments, foundations and private sector players from across industries.

The programme is the first of its kind in aiming to build the resilience of an entire health system. Although still in its early stages, it has already won Nigeria's Excellence Award for 2015, which recognizes efforts in healthcare delivery.

2. Harmonizing Public-Private Networks: The Key for Early Detection and Response

Coordination and time are invaluable assets in an emergency, so mechanisms that bring together public and private players in high-risk geographies to address emerging epidemics are likely to pay dividends. Although response measures remain primarily international, harnessing the potential of national and local actors to optimize early detection and response on the ground is also critical.

Local actors or in-country operators (multinationals and small or medium-sized enterprises) have the greatest incentive to act swiftly in any outbreak or epidemic.[23] They are motivated not only by responsibility to their communities but also by a desire to protect their operations, maintain business continuity and reduce business risks. Embedded in their communities, and often operating in remote areas with little public infrastructure, they are likely to see emerging public health issues at an early stage. They also have the capacity to raise an alert in the event of an emerging threat.

The potential of private sector actors to contribute in an emergency was prominently witnessed in the Ebola crisis. Although several multinationals chose to shut down their operations and leave the area, many others – along with domestic businesses – maintained their presence and contributed meaningfully to the response through channels such as the Ebola Private Sector Mobilizing Group (EPSMG). In-country operators such as ArcelorMittal conducted initiatives on community awareness and screening programmes, and used their machinery and capacity to construct Ebola Treatment Centres. Alcoa educated its employees and their families on the transmission of Ebola and taught them how to protect themselves. Firestone built its own isolation and treatment centre in its facility after a case was detected and nearby hospitals were unable to accommodate the patient. Beyond funding and in-kind donations, local actors also played an important role in influencing decision-makers and mobilizing each other: the Sierra

Leone EPSMG chapter successfully lobbied to keep national ports open, which enabled crucial supplies to be shipped in as well as minimized the loss of livelihoods through disruption to economic activity.

Although these and many similar efforts deserve and have received recognition, a lack of coordination limited the ability of the private sector to apply its full set of capabilities, and their interactions were not aligned with public sector efforts on a day-to-day basis. Local companies did not always know how best to contribute to the response, and national governments and responding agencies were not always aware of potential opportunities to partner with the local private sector.

Building on the flexible partnership responses that complemented the channels of official assistance to Ebola-affected countries, the Forum has drawn up a wide set of recommendations for public-private cooperation models to manage any potential future outbreaks more effectively and reduce the risk of their occurrence. The study disaggregates private sector interventions into three categories – in-country operators, expert capability companies and greater private sector contributors – and makes specific recommendations for each category to enhance collaboration. At a high-level dialogue in Cape Town, senior leaders expressed a desire to home in on optimizing local actors in early detection and response plans.

With subsequent endorsement from partners including the United Nations, the African Development Bank and the Wellcome Trust, the Forum has launched a 12-month initiative to mobilize in-country business operators and facilitate dialogue with ministries of health for the local implementation of networks in national preparedness and response schemes. This entails the creation of country-wide playbooks and communication platforms between local actors across sectors to develop a rapid and efficient response in the event of an epidemic. Networks and their implementation roadmaps will be designed for specific high-risk geographies including Mali, Guinea, Liberia and Nigeria, with the vision of defining a broader coordination mechanism to expand regionally and apply globally.

3. Big Data and Infectious Diseases: Mapping the Outbreak

One key to determining how viruses spread is to understand how people move around and interact with one another on a daily basis. Big data allows the modelling of how a virus spreads, and the potential for it to be contained by various possible interventions.

The 2009 H1N1 Swine Flu pandemic response in Mexico is an early example of how mobile phone data can be used. As the outbreak began to spread, the Mexican government acted to limit the movement of people, advising them to stay away from public places such as airports, hospitals and universities. A digital research team in Telefónica, one of Mexico's largest mobile network providers, saw an opportunity to test the effectiveness of the advice by analysing patterns of movement. Drawing from anonymized mobile phone call records of 1 million customers in one of Mexico's most affected cities, the team found that call traffic was lower or stable in hospitals and universities but increasing at the airport, suggesting that people were ignoring government advice and trying to leave the area.

Next, the team created a model to simulate what would have happened if the government had not intervened. Analysing more than five months of encrypted call records, including the period of government interventions, the research team found that the intervention had resulted in between a 10% and 30% drop in movement, postponed the peak of the epidemic by nearly two days and reduced the number of infections by 10%.[24]

A more recent intervention has been witnessed in the use of GPS technology in the roll-out of treatment-as-prevention to control the HIV pandemic in Sub-Saharan Africa to construct predictive prevalence maps for migrating populations.[25] Health workers can immediately report newly identified cases through solar radios or a new mobile application, facilitating social network analysis. The resulting communications and data collection system allows for faster identification of transmission chains, which in turn allows for faster isolation of potentially contaminated individuals and a more effective implementation of ring vaccination when necessary.

The Ebola crisis also saw innovative attempts to use technology to predict, detect and prevent new cases, such as the mHero platform – supported by a consortium of partners including UNICEF, UNAIDS and IntraHealth – to connect ministries of health with frontline workers using text messaging services and analyse the resulting data. However, the lack of interoperability of data information systems between responders in the crisis highlighted the need to review new fabric architecture, diagnostics and logistics. The mHero platform is under development to overcome these barriers.[26]

Finding the fastest and most efficient channel to disseminate information is key to fighting an infectious disease outbreak, and access to data for real-time monitoring, multi-path surveys and detailed analysis is essential. The better the information, the more sure decision-makers can be of their strategy. Real-time sharing of data in a coordinated and collaborative manner can make responses more efficient. If ways can be found to reconcile the need for data with current regulatory environments and the legitimate right to data privacy, lessons from the Ebola crisis could potentially be applied in future emergency settings.

Endnotes

[1] A well-functioning health system working in harmony is built on having trained and motivated health workers, a well-maintained infrastructure and a reliable supply of medicines and technologies, backed by adequate funding, strong health plans and evidence-based policies (WHO 2015).

[2] UN DESA 2015.

[3] Zoonoses – pathogenic organisms such as bacteria or viruses that humans share with animals – cause more than 60% of human infectious diseases and have been responsible for some of the most devastating disease outbreaks in recent years, including HIV, Ebola and SARS. See http://www.thelancet.com/series/zoonoses. More than more than 60% of the roughly 400 emerging infectious diseases that have been identified since 1940 are zoonotic. See Jones et al. 2008.

[4] Gubler 2011.

[5] Coburn et al. 2013.

[6] Estimates suggest that in the United States at least 2 million people acquire serious infections with bacteria that are resistant to one or more of the antibiotics designed to treat them, and at least 23,000 people die each year as a direct result of these antibiotic-resistant infections. Estimates of economic costs range as high as US$20 billion in excess direct healthcare costs, with additional costs to society for lost productivity as high as US$35 billion a year (2008 dollars). See http://www.tufts.edu/med/apua/consumers/personal_home_5_1451036133.pdf (accessed 8 May 2013); extrapolated from Roberts et al. 2009.

[7] Review on Antimicrobial Resistance 2015.

[8] Butler 2015.

[9] Butler 2015.

[10] World Economic Forum 2015a.

[11] UNICEF 2015.

[12] UNDG 2015.

[13] World Bank 2015.

[14] World Bank 2015.

[15] World Bank 2014b.

[16] World Bank 2015.

[17] World Bank 2014a.

[18] Keogh-Brown and Smith 2008.

[19] Heymann et al. 2015.

[20] Zimmer 2015.

[21] USAID 2015.

[22] World Economic Forum 2015b.

[23] World Economic Forum 2015b.

[24] Telefónica 2013.

[25] Coburn and Blower 2013.

[26] USAID 2015.

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Part 4: Risks for Doing Business at a Glance

Building resilience against global risks necessitates consensus in identifying the risks that should most concern different stakeholders across regions and countries. The final part of *The Global Risks Report* therefore focuses on the impact of global risks on the business community across different regions and countries. It draws on the views of executives in 140 economies covered by the World Economic Forum's Executive Opinion Survey (see Box 4.1) about the risks of highest concern for doing business.[1]

The fact that today's businesses are global is not news, but the extent of the globalization of trade and commerce – and the risks it presents – is far from understood. Foreign direct investment (FDI) inflows have increased a staggering 25-fold since 1980, rising from US$54 billion to US$1.23 trillion in 2014,[2] as marked by shifts from manufacturing to services and from developed to developing and emerging markets. Indeed, South-South investments (that is, investments from one developing economy to another) have intensified, growing by two-thirds, from US$1.7 trillion in 2009 to US$2.9 trillion in 2013.[3] Information and communications technologies (ICTs) have internationalized supply chains, linking trade and investment ever more tightly.[4] While offering companies opportunities to lower production costs and countries the chance to develop economically by participating in global value chains, the internationalization of business increases exposure to global risks. From environmental to economic and political risks, companies are vulnerable even if they have no immediate presence in the geography where the risk arises.[5] The resilience of any individual business depends heavily on the resilience of its suppliers and purchasers, whose supply chains can span many countries.

Increasingly, businesses need to strengthen their scenario and emergency planning capacity to analyse complex and often uncertain interdependencies if they are to build resilience to global risks. Likewise, countries also need to understand the global risks to doing business. Globally, FDI inflows fell by 16%, from US1.47$ trillion in 2013 to US1.23$ trillion in 2014 – well below the pre-crisis 2007 peak –

for reasons that include perceptions of global economic fragility, government policy uncertainty and elevated geopolitical risks.[6]

This part of *The Global Risk Report 2016* therefore aims to provide insight for both business and policy-makers by drawing on the findings of the Forum's Executive Opinion Survey (EOS) about the risks for doing business in 140 economies. It takes the global risks discussed in previous chapters to the country level and analyses regional trends, country-specific responses and presents deep-dives into the five often-cited risks of highest concern.

Box 4.1: The World Economic Forum's Executive Opinion Survey

Every year since 1979, the World Economic Forum has conducted its Executive Opinion Survey (EOS). Capturing executives' perspectives on a broad range of socio-economic issues, the EOS primarily informs the World Economic Forum's annual *Global Competitiveness Report* and its derivatives. The 2015 edition of the EOS, conducted between February and June 2015, surveyed over 13,000 executives in 140 economies. EOS respondents were asked to **select the five global risks that they were most concerned about for doing business in their country within the next 10 years,** choosing from the set of 28 global risks presented in the *The Global Risks Report 2015*.[1] See Appendix C for details of the methodology and the EOS.

Note
[1] Following an expert review in spring 2015, the set of risks was increased from 28 to 29 global risks in this year's *Report*. Formerly part of the risk of national governance, illicit trade is now treated as a separate global risk. See Appendix B for details regarding the difference in the list of global risks from last year and this edition.

Regional Analysis

The risks of highest concern for doing business differ considerably from country to country, according to EOS data. However, some patterns emerge. In developed economies, economic risks such as asset bubbles and fiscal crises are high on the business agenda; concern is also present about technological risks such as cyberattacks and data theft. In these economies, it is increasingly evident that connectivity plays a central role in production processes, service provision and everyday life. In emerging and developing economies, the top concern is unemployment and underemployment as well as potential energy price shocks.

A striking finding is the relative absence of environmental risks and, more generally, of long-term issues among the top concerns of business leaders in their respective countries. For instance, no executive considers failure of climate mitigation and adaptation as the number one risk for doing business in his/her country. This stands in contrast to the priorities considered by members of the multistakeholder community of the World Economic Forum who took part in the Global Risks Perception Survey and perceived it as the most impactful and the third most likely risk on a global scale (see Figure 1). This finding highlights the

Figure 4.1: Global Risk of Highest Concern for Doing Business, by Country

Source: Executive Opinion Survey 2015, World Economic Forum.

Note:
In addition to the risk indicated on the map, the following countries have another risk as the risk of highest concern:
Haiti: Unemployment or underemployment; Oman: Energy price shock; Peru: Profound social instability; Paraguay: Failure of financial mechanism or institution; Senegal: Energy price shock; Tunisia: Profound social instability; Venezuela: Unmanageable inflation; Vietnam: Man-made environmental catastrophes.

divergence between national and global interests when it comes to some global risks such as climate change. It also calls for continued alignment across stakeholders whose actions are based on different time horizons.

The top global risks for doing business for each country are shown in Figure 4.1. Full economy-level data are available at www.weforum.org/risks. Throughout Part 4, the ranking of risks refers exclusively to the EOS question on risks of highest concern for doing business.[7]

Europe

Across Europe,[8] the risks that stand out as being of great concern for doing business are all in an economic category. Unemployment or underemployment is mentioned as the risk of highest concern for doing business in 12 countries in Europe and is among the top five risks in 25 countries (Table 4.1).

Table 4.1: Europe: Percentage of Economies in which a Risk Appears among the Top Five of Highest Concern for Doing Business

Risk	Percent
Fiscal crises	67
Unemployment or underemployment	64
Failure of financial mechanism or institution	62
Energy price shock	56
Asset bubble	51

Note: 39 economies considered

Unemployment threatens to de-skill an entire generation in parts of Europe, further aggravating businesses' search for employees with the right type of skills to compete in today's fast-paced global economy. These concerns are not limited to the crisis-hit Southern European economies – such as Cyprus, Greece, Italy, Portugal and Spain – where unemployment remains well into the double digits eight years after the crisis, well beyond a typical business cycle. They are also strong in countries such as Austria, Finland and France, where unemployment rates are considerably lower although historically high;[9] in Poland and Macedonia, where more than half of youth are unemployed;[10] and in the Balkans, with unemployment sky-rocketing in Serbia and Bosnia and Herzegovina.[11] Along with challenges related to involuntary migration, high unemployment rates may help to explain why the risk of profound social instability also features prominently in Southern and Eastern Europe.

The risk of an asset bubble is the top concern in Iceland, Luxembourg, Norway, Sweden, the United Kingdom. A related economic risk causing concern across Europe is fiscal crises (this is the risk of highest concern in four countries and is among the top five in 26 countries); although fiscal consolidations are starting to pay off, government debt in advanced economies is projected to aggregate at 104.2% of GDP in 2016, much higher than the pre-crisis level of 71.6% in 2007.[12]

Although the extent of concern about cyberattacks is somewhat lower than the above-mentioned risks (this risk is among the top five of highest concern in 12 countries), it is of high concern in Estonia, Germany, the Netherlands and Switzerland. Given the cross-border nature of cyberspace, there is obvious potential for cyberattacks to have ramifications well beyond the countries in which they occur.

North America

In North America, which includes the United States and Canada, two risks have been selected as being among the five of highest concern for doing business in both countries: cyberattacks and asset bubbles (Table 4.2).

In the United States, the top risk is cyberattack, followed by data fraud or theft (the latter is in 7th position in Canada, which is why it scores 50% in Table 4.2). Interestingly, the risks related to the internet and cyber dependency are considered to be of highest concern for doing business, following recent important attacks on businesses. The United States is extremely well connected, and ICT usage is high – 87% of the population use the internet,[13] and the country ranks second globally for online business-to-consumer transactions.[14] The risk of terrorist attacks is third on the list (and 13th in Canada): according to the House Committee on Homeland Security, the home-grown Islamist extremist threat in the United States has escalated dramatically in 2015, with more terror cases than in any full year since September 11, 2011.[15]

Table 4.2: North America: Percentage of Economies in which a Risk Appears among the Top Five of Highest Concern for Doing Business

Risk	Percent
Cyberattacks	100
Asset bubble	100
Energy price shock	50
Fiscal crises	50
Failure of critical infrastructure	50
Failure of climate change adaptation	50
Terrorist attacks	50
Data fraud or theft	50

Note: 2 economies considered

Energy price shock to the global economy tops the list of concerns in Canada, with the commodity price drop hurting the Canadian economy and GDP growth projected to be around 1% in 2015, compared with 2.4% in 2014.[16] The risks of asset bubble and cyberattacks come second and third in Canada (fifth and first in the United States, respectively).

Asia and the Pacific

Central Asia and Russia

The end of the commodity boom, the economic slowdown in Russia, the weaker-than-expected growth in China and the slow recovery in the Eurozone are among the factors putting pressures on Central Asia's economies.[17] Although the region's countries feature a diverse range of risks of highest concern for doing business, the most prominent are fiscal crises, unmanageable inflation, interstate conflicts and unemployment and underemployment (Table 4.3).

Table 4.3: Central Asia and Russia: Percentage of Economies in which a Risk Appears among the Top Five of Highest Concern for Doing Business

Risk	Percent
Fiscal crises	100
Unmanageable inflation	86
Unemployment or underemployment	71
Interstate conflict	71
Failure of financial mechanism or institution	57

Note: 7 economies considered

Oil-exporting countries are suffering from lower prices and volumes of trade, which negatively affects government revenues; and while the lower price is helping the region's oil importers, it is unlikely to make up for the effects on fiscal balances of weak domestic demand and Russia's economic contraction. Rising public debt helps to explain why fiscal crises are one of the top three concerns in all the region's countries. With only moderate economic prospects, unemployment is likely to surge in the region and is among the top five risks of highest concern in five countries.

A combination of factors could explain the fear of unmanageable inflation in several of the region's countries. These factors include the recent volatility in foreign exchange markets, with regional currencies depreciating against the US dollar and reserve losses;[18] a second factor is the relatively recent experience of hyperinflation during the 1990s transition period;[19] and a third is the concern that weak institutions will be unable to implement the deep structural and fiscal reforms necessary to foster sustainable growth.

The dispute between Russia and Ukraine, the annexation of Crimea, and Russian military intervention in Syria are among many geopolitical developments in the region that may be affecting the views of business executives who mentioned the risk of an interstate conflict with regional consequences.

East Asia and the Pacific

The global risks of highest concern for doing business in East Asia and the Pacific are mainly economic: energy price shock and asset bubble (Table 4.4).[20] While energy price shock tops the list only in Lao PDR and Indonesia, it is among the top five in 12 countries. Many countries in the region are energy importers and soaring prices could be damaging. The risk of an asset bubble ranks top in seven economies (Australia, Cambodia, China, Hong Kong SAR, Myanmar, New Zealand and Thailand), reflecting the recent equity market turmoil in China and potential spillovers into the other countries from the region as well as over-evaluation of property in some of the economies such as Hong Kong or Sydney.

Fiscal crises is among the five most concerning risks for 41% of executives in the region. The slowdown of the Chinese economy is likely to moderate growth and could negatively impact public finances in neighbouring countries.[21] Along with these two risks, cyberattacks – the risk of highest concern for doing business in three economies – is further explored in the deep-dives below.

Table 4.4: East Asia and the Pacific: Percentage of Economies in which a Risk Appears among the Top Five of Highest Concern for Doing Business

Risk	Percent
Energy price shock	71
Asset bubble	59
Cyberattacks	41
Fiscal crises	41
Natural catastrophes	35
Unemployment or underemployment	35
Unmanageable inflation	35

Note: 17 economies considered

One of the features of the region is how frequently environmental risks are mentioned. For example, executives in both the Philippines and Myanmar identified extreme weather events as among their leading concerns, in the wake of the recent experiences of Typhoon Haiyan and Cyclone Nargis, respectively.[22] Executives are concerned about the region's vulnerability to natural catastrophes – earthquakes, tsunamis, volcanic eruptions and geomagnetic storms – as well as man-made environmental catastrophes, emphasizing the importance for business of sustainable development that respects the environment. In New Zealand, the most worrisome risk for executives is natural catastrophes, reflecting that the country's position on the Alpine Fault makes it vulnerable to earthquakes and tsunamis. The region's need to build resilience against climate and weather risks could also help to explain why risks such as failure of critical infrastructure and national governance rank high in some of the economies.

South Asia

With four of the region's countries identifying energy price shock and three economies identifying fiscal crises among their top five, concern for doing business is centred on economic risks (Table 4.5).[23] Unemployment and underemployment is also among the most-cited risks in South Asia, with the whole region facing the challenge of jobless growth and vulnerable and informal employment: vulnerable employment accounted for over three-quarters of all employment in 2014 in South Asia.[24] Youth unemployment is also a concern, especially in South Asia, where the rate is already four times higher than among adults and an additional 2.1 million youth will enter the labour force over the next five years.[25]

Table 4.5: South Asia: Percentage of Economies in which a Risk Appears among the Top Five of Highest Concern for Doing Business

Risk	Percent
Energy price shock	67
Failure of national governance	67
Fiscal crises	50
Unemployment or underemployment	50
Failure of climate-change adaptation	50

Note: 6 economies considered

Failure of national governance is another leading concern, highlighting the difficulties posed for business in the region by the current unstable political situation: for instance, according to the Corruption Perception Index, Nepal ranks 126th and Bangladesh 145th out of 175 economies.[26]

Latin America and the Caribbean

Failure of national governance is a prominent concern across Latin America and the Caribbean,[27] especially in South America, where corruption and mistrust in the functioning of institutions are increasingly compounding the difficulties of running a business (Table 4.6). The region's weak economic growth prospects and low levels of investment lie behind concerns about failure of critical infrastructure;[28] increasing investment in infrastructure would stimulate the economy as well as strengthen resilience to global risks.

Table 4.6: Latin America and the Caribbean: Percentage of Economies in which a Risk Appears among the Top Five of Highest Concern for Doing Business

Risk	Percent
Failure of national governance	91
Energy price shock	82
Unemployment or underemployment	64
Profound social instability	59
Fiscal crises	45

Note: 22 economies considered

The region relies heavily on exports of commodities that have declined in price – such as oil, gas, copper and iron – explaining the prominence of the risk of an energy price shock among the region's leading concerns. Low commodity prices reinforce existing challenges such as high public debt and low economic growth, and increasing the associated risk of fiscal crises.

Finally, concerns about unemployment reflect how skills mismatch and rigid labour markets are affecting business development in the region.

Middle East and North Africa

Executives in oil-exporting countries in the Middle East and North Africa are most concerned about the risk of an energy price shock (the top concern in nine countries) (Table 4.7),[29] with low prices already leading to a decline of exports and revenue, hurting public finances, undermining financial planning and ultimately threatening to expose often-insufficient diversification of the economy.

Table 4.7: Middle East and North Africa: Percentage of Economies in which a Risk Appears among the Top Five of Highest Concern for Doing Business

Risk	Percent
Unemployment or underemployment	71
Energy price shock	71
Fiscal crises	71
Terrorist attacks	64
Asset bubble	43
Interstate conflict	43

Note: 14 economies considered

Unemployment or underemployment, especially among youth, is also of high concern in the region, with youth unemployment as high as 33% in Jordan (2013 data) and above 20% in Oman, Saudi Arabia, and Algeria.[30] Informal employment is a growing trend,[31] adding to the potential for the job market situation to fuel profound social instability – a risk that makes the top five in five countries amid a regional humanitarian crisis that sees neighbouring countries coping with refugees from Syria. One in four of the world's refugees is now Syrian, with 95% located in surrounding countries;[32] in Lebanon, over a fifth of the population is refugees. Another potential cause of social disruption is water crises (among the top five risks in four countries), a particular concern for business because water is a key input in many industries,[33] agricultural products and energy production.

Unsurprisingly, the risks of terrorist attacks and interstate conflict also weigh on the minds of executives, as a proliferation of conflicts is putting the region's geopolitical stability at stake.

Sub-Saharan Africa

By 2035, Sub-Saharan Africa is projected to have more young people reaching working age than the rest of the world put together.[34] This demographic pressure helps to explain why unemployment and underemployment is the most concerning risk for executives in the region. Creating high-productivity, non-agricultural jobs is among the region's biggest challenges, requiring businesses to adapt and diversify. Failure to reform Sub-Saharan Africa's labour market could fuel social instability, another widespread concern according to survey respondents (Table 4.8).

Table 4.8: Sub-Saharan Africa: Percentage of Economies in which a Risk Appears among the Top Five of Highest Concern for Doing Business

Risk	Percent
Unemployment or underemployment	88
Energy price shock	70
Failure of national governance	55
Failure of critical infrastructure	45
Fiscal crises	39

Note: 33 economies considered

With fiscal pressures increasing for oil and gas exporters, the risk of energy price shock is prominent in executives' thinking. The aggregated benefits of lower prices for the region's oil importers are likely to be offset by falls in the prices of other commodities that they export.[35] The macroeconomic climate is a related concern, especially fiscal crises and inflationary pressures.

Africa's urban population is expected to triple by 2025,[36] as reflected in the prominence of the risk of failure of urban planning and pointing to the need for more investment in urban infrastructure. This helps to explain why failure of critical infrastructure is another high-ranking risk: lack of infrastructure – both physical and virtual – is

estimated to reduce company productivity up to 40%.[37] The cost of filling the gap in Africa's infrastructure has been estimated at around US$93 billion a year.[38]

Deep-Dives into Five Global Risks

Between them, two economic risks account for the global risks of most concern for doing business in half of the 140 economies covered: unemployment or underemployment, and energy price shock. Third on the list is failure of national governance, which affects businesses in many ways, including the failure to stamp out illicit trade (Table 4.9).

Table 4.9: Number of Economies in which a Risk Appears as the Risk of Highest Concern for Doing Business

Risk	Number
Unemployment or underemployment	41
Energy price shock	29
Failure of national governance	14
Asset bubble	11
Fiscal crises	10
Cyberattack	8

Note: out of 140 economies globally

The below deep-dives into the implications for business also explore asset bubbles, fourth on the global list, and cyberattacks, among the top three risks in 18 economies. While not exhaustive, these analyses of mechanisms through which these global risks affect businesses at the national level are intended to raise awareness of the need for action.

Unemployment or Underemployment

Unemployment or underemployment is perceived as the global risk of highest concern for doing business in 41 countries, and is among the top five global risks in 92 countries (Figure 4.2). Unemployment affects business in multiple ways, from holding back economic growth to threatening social stability. With a growing mismatch between the skills demanded by a fast-changing jobs market and those possessed by unemployed workers, businesses are struggling to recruit workers with the capabilities they need. Expected job growth is concentrated in occupations for which today's workers are inadequately prepared.

Structural unemployment has increased in all major economies since the 2007 crisis. Even where growth has picked up, labour productivity and job creation often have not. Layoffs disproportionately affected middle-skilled jobs, while most job creation in the recovery has taken place in lower-wage jobs and in temporary and fixed-term employment. At the same time, technological disruptions and the move towards automation are accelerating change in the nature of work. Currently it is estimated that by the year 2020 nearly half of all current occupations could be affected by advances in robotics and machine learning.[39]

Given the unprecedented nature and pace of these displacements, large-scale reforms will be needed, both by government and business. Short-term, reactive measures based on past successes will not be enough: for example, efforts to place unemployed youth in apprenticeships in certain job categories may not be a high-value investment if that job category is likely to be obsolete in five years' time as a result of automation or other disruptions, while growth comes from wholly new occupations. Three main reforms are needed.

First, the education systems must be redesigned to focus on learning to learn and collaboration. As knowledge-based work will increasingly be handled by technology, we need to educate future generations in skills where humans can still be expected to outperform machines – collaboration-based attributes such as teamwork, interaction, relationships and cultural sensitivity. In a more automated future, value will come from emotional and contextual intelligence.

Figure 4.2: Unemployment or Underemployment, rank

Source: Executive Opinion Survey 2015, World Economic Forum.
Note: The darker colour, the higher the concern.

Second, while businesses must work with educators and governments to help education systems keep up with the needs of the labour market, companies must also fundamentally re-think their role as consumers of ready-made human capital, obtaining pre-trained talent from schools, universities and other companies. Some companies understand this and are investing more in the continuous learning, re-skilling and up-skilling of their employees. Given the ongoing rapid changes in the skill sets required for many occupations, talent management is no longer the preserve of the human resources function but will be a critical part of any company's growth and innovation strategy – especially with younger cohorts of workers increasingly valuing a sense of purpose and diversity of experiences in their working lives.

Third, governments must look beyond the education system to redesign the broader enabling environment for talent. Human capital development depends on a series of interventions across a person's lifetime, including hiring and firing practices, women's integration, retirement policies, visa regulations, social safety nets, and, in particular, regulatory support for entrepreneurship and small and medium-sized enterprises – one of the most under-utilized means of unleashing creativity, enhancing growth and generating employment. Such areas often go neglected by policy-makers because reforms are unlikely to pay off within the timeframe of political tenures.

Energy Price Shocks to the Global Economy

With lower oil prices making the headlines recently, the risk of energy price shocks to the global economy ranks first in 29 out of the 140 economies represented in the 2015 EOS and appears in the top five risks in 93 of them (Figure 4.3).

"Price shocks" can refer to either sudden increases or decreases in the price of energy – whether in the form of electricity, oil, natural gas or liquid fuels derived from these sources. From 2010 until June 2014 world oil prices were fairly stable, at around $110 a barrel for Brent crude; since then they have ranged between around US$45 to US$60, a plunge that surprised many. Natural gas prices, often indexed to oil, have followed a similar trajectory. This has resulted in significant shifts of wealth from oil and gas producers to consumers, meaning lower input costs for industry, lower inflation and more money available to spend in other sectors.

The outlook for oil prices is uncertain. On the supply side, one key factor is whether or not the Organization of the Petroleum Exporting Countries (OPEC) – and in particular Saudi Arabia – will continue with its strategy of not curtailing production despite price declines. Another factor is the extent to which investment will fall in response to low prices, leading to a potential rise in unemployment rate of oil-exporting countries. Key oil and gas producers are estimated to have cut over US$200 billion in capital expenditure on new projects, deferring oil and gas projects with reserves equating to 20 billion barrels of oil equivalent.[40]

If current low prices continue, the implications for oil-exporting countries may be severe. For instance, oil export losses in 2015 are expected to reach about US$300 billion in the Gulf Cooperation Council (GCC),[41] which will have a heavy impact on governments' budget balances. The International Monetary Fund expects more than 10 million people to be looking for work by 2020 in the region's oil-exporting countries, which will challenge fiscal sustainability over the medium term. A combination of rising import prices hurting the populations of many oil-producing countries and a lack of job opportunities may lead to social instability.[42]

Whether demand for oil picks up depends on factors such as whether growth recovers in China and other emerging economies, as well as the extent to which economies become less fuel intensive as a consequence of new technology and energy-efficiency measures. It is possible that if prices start to recover, they

Figure 4.3: Energy Price Shock to the Global Economy, rank

Source: Executive Opinion Survey 2015, World Economic Forum.
Note: The darker colour, the higher the concern.

could unexpectedly spike: with the current low prices leading to reduced investment and job losses, there is less slack in the system to deal with unanticipated demand increases.[43]

Such a price spike could lead to slower global output and disrupt business models. Even many developed countries are vulnerable – for example, geopolitical tensions threaten energy security in Europe, which gets around a quarter of its gas from Russia.[44] Still, the risks of a price spike destabilizing society are greatest in less-developed economies, which are highly dependent on imports and have little scope for alternatives to take up the slack. Indeed, the risks associated with an undiversified energy sector are not limited to oil – for example, in 2008 water shortages caused by an extremely harsh winter impacted energy production in Tajikistan, which relies heavily on hydro power. Ramifications in that instance included interruptions in medical care for many people (power shortages and cold weather deprived more than 50% of the country's hospitals of their water supply).[45]

Failure of National Governance

Failure of national governance is perceived as the highest risk to doing business by executives in 14 economies – half of them in Latin America, four in Sub-Saharan Africa, two in Eastern Europe and one in Asia (Figure 4.4). This risk captures the inability to efficiently govern a nation, which is caused by or results in factors such as weak rule of law, corruption, illicit trade, organized crime, impunity, and political deadlock. Weak national government is not the result only of poor governance; governance is a multi-faceted phenomenon in which business, civil society and the general public also play roles.

As discussed in the most recent edition of the World Economic Forum's *Global Competitiveness Report*, the consequences of failures of governance seriously undermine many countries' competitiveness, job creation and economic development. Weak or failing national governance creates space for organized criminals and terrorists to profit from illegal trading in humans, weapons, counterfeit goods, and so on. The cross-sector and transnational nature of these illegal activities means they pose a risk to all, creating economic, social, and environmental damage at regional and global levels.

Businesses face additional risks as well as costs from operating in countries affected by poor governance. Both the risks and the costs arise from the difficulties of working in an unpredictable environment and complying with international standards when fragile governments do not themselves adhere to international regulatory regimes. These costs can be serious enough to become unsustainable in the long run.

One aspect of poor governance – illicit trade – can undermine corporate brands and supply chains, because logistics and transport sectors often unwittingly contribute to the spread of illicit goods. Illicit trade is estimated to cost the world economy up to US$2 trillion, although it is difficult to quantify accurately.[46] Counterfeiting and piracy alone are estimated to amount to US$1.77 trillion in 2015,[47] nearly 10% of world merchandise trade.[48]

The World Economic Forum's Meta-Council on the Illicit Economy has published, in its *State of the Illicit Economy* report, a range of suggested ways in which technological improvements can be leveraged as solutions in this space:

- ***Big data.*** Sex traffickers have been uncovered by a collaboration among financial institutions, the Thomson Reuters Foundation, and New York prosecutors.[49]
- ***Satellite tracking.*** Illegal fishing is being tackled by the Eyes on the Seas project – a digital platform that helps governments to monitor the world's oceans, backed by the Pew Charitable Trusts.[50]
- ***Crowdsourcing.*** In combination with big data and satellite tracking, Global Forest Watch is enabling the tracking of illegal forestry operations by using crowdsourcing

Figure 4.4: Failure of National Governance, rank

Source: Executive Opinion Survey 2015, World Economic Forum.
Note: The darker colour, the higher the concern.

to combine images and provide near-real time data on the world's forests.[51]

- ***DNA analysis.*** A genetic library of life on Earth is being used to detect food fraud,[52] while forensic laboratories are able to link stolen ivory to specific animals.[53]
- ***Encryption:*** Although organized criminals use encryption to evade detection, it can also be used to enable the secure sharing of information between law enforcement organizations and the private sector.

Individual companies can take some steps to protect their own operations, reputation or assets – but for businesses to build resilience against the risk of failure of national governance ultimately requires finding ways to contribute towards improving the overall situation. That includes setting an example for political leaders by upholding international best practice, frameworks and standards, and looking for ways to collaborate with governments and civil society on the development of more coherent policies and smart governance strategies. It is clear that the problem cannot be resolved with policies alone, but requires the support of the business sector as well as awareness of the general public. Discussions need to move beyond political commitment – the public sector, private sector and civil society need to come together to build relationships, initiatives and mechanisms to curb the rates of illicit trade.

Asset Bubble

Executives in 11 economies, mostly in Europe and Asia, rate asset bubbles as their highest concern; it ranks among the top five risks in 40 countries, representing more than half of the world GDP (Figure 4.5). Far from affecting only speculators, the bursting of asset bubbles hits businesses across the whole economy – particularly where leverage induces contagion through the banking system. As business confidence falls, so do consumption, incomes and investment, which can lead to a prolonged recession.

The trigger for the global financial crisis, to take one example, was a widespread default on US subprime mortgages and loss of value of related securities. The bursting of the dot-com bubble in 2000–2002 destroyed US$5 trillion of stock market wealth in the United States (equivalent to half of annual GDP) in 30 months.[54] Japan was mired in a low-growth deflationary environment for over two decades after this combined real estate and stock market bubbles burst in the early 1990s.

Recent global economic developments have increased both the likelihood and potential impact of bubbles. In many countries, monetary and fiscal policy after the financial crisis of 2007–2008 had some success in stimulating the economy to minimize the depth of the recession. However, as post-recession growth proved elusive, easy monetary policy was maintained or even stepped up. Low interest rates sent investors on a search for yield, creating an environment that is highly conducive to bubbles. The impact of another bubble bursting now in a major economy would be especially damaging because the weakness of the recovery and high levels of government debt mean there would be little remaining policy space for further stimulus.

Asset bubbles can never be identified with certainty while they are building up, as there is always a narrative of "this time is different". Nonetheless, when attempting to evaluate the risk of a bubble bursting, three types of potential bubbles can be distinguished:

- ***Equity bubbles.*** These bubbles are often a side effect of low interest rates, as investors look to stock markets for higher yields than they can get from fixed income assets. Companies can use their highly-valued stock to make cross-border acquisitions – but when the bubble bursts, they can in turn become takeover targets for companies in other countries.

Figure 4.5: Asset Bubble, rank

Source: Executive Opinion Survey 2015, World Economic Forum.
Note: The darker colour, the higher the concern.

- ***Real estate bubbles.*** Real estate bubbles are not usually a major concern for companies while they are inflating, though they make office and factory space more expensive. However, because banks play a major role in real estate finance, the bursting of a real estate bubble can have catastrophic impacts on business finance, as seen recently in Ireland: with banks struggling, credit can dry up completely and companies find it hard to finance their operations.
- ***Government bond bubbles.*** Government bonds might be inflated by a quantitative easing of purchases by central banks and new liquidity requirements increasing demand among private sector banks. As prices are pushed up, yields go down, which drives investors into higher-yield corporate bonds, raising the risk of a bubble here, too. In the short term, this can be good news for corporate issuers – but the ending of quantitative easing programmes could rapidly make it harder for businesses to raise capital. Some observers have raised concerns about whether current market structures can deal with the resulting large swings in demand for bonds, potentially triggering severe volatility in the financial system.

The bursting of any of these three types of bubble can tip an economy into recession. For consumer-facing businesses without regional or global diversification, this is a concern that is not easily mitigated. Besides shoring up the balance sheet – for example, by issuing long-dated debt – and putting adequate credit lines in place, most mitigation mechanisms would be more strategic and affect the business model, such as alliances to tap more diversified markets.

From a policy perspective, some studies suggest that the development of financial markets – with increased integration, sophistication of trading techniques, and removal of frictions to arbitrage – may be increasing the prevalence of bubbles.[55] A fundamental rethink of regulation and contract design in financial markets could be necessary, to accept the inevitability of bubbles and seek to limit their scope.

Cyberattacks

From personal finances to business operations and national infrastructure, public and private services and amenities are increasingly managed via some form of computer network and are consequently vulnerable to attack. The Internet of Things is a growing reality, introducing new efficiencies as well as new vulnerabilities and interconnected consequences. Recent technological advances have been beneficial in many respects, but have also opened the door to a growing wave of cyberattacks – including economic espionage, cybercrime, and even state-sponsored exploits – that are increasingly perpetrated against businesses (Figure 4.6). In 2014, The Center for Strategic and International Studies and McAfee estimated that cybercrime alone cost the global economy US$ 445 billion.[56] Businesses in all industries and of all sizes have been affected by the increased complexity, novelty and persistence of cyberattacks, with consequences ranging from the reputational to economic and legal. A sharp increase in high-profile cases in 2014 has continued into 2015, and shows no sign of slowing down.

The EOS results indicate that cyberattack is perceived as the risk of highest concern in eight economies: Estonia, Germany, Japan, Malaysia, the Netherlands, Singapore, Switzerland, and the United States. Public sector bodies in at least two of these countries have recently been disrupted by cyberattacks: the US Office of Personnel Management and the Japanese Pension Service. The 2015 Fortune 500 CEO survey found that cyber security came second when CEOs were asked about their companies' biggest challenges.[57]

Attempts to detect and address attacks are made harder by their constantly evolving nature, as perpetrators quickly find new ways of executing them.

Figure 4.6 Cyberattacks, rank

Source: Executive Opinion Survey 2015, World Economic Forum.
Note: The darker colour, the higher the concern.

Businesses trying to match this speed in their development of prevention and response methods are sometimes constrained by a poor understanding of the risk, a lack of technical talent, and inadequate security capabilities. Although CEOs worry about rising cyber risks, the ownership of and responsibility for the cyber risk is less clear. Who in the corporation is the actual owner of the risk? While there are many "C" level owners (CISO, CFO, CEO, CRO, Risk Management), each of these owners has differing but related interests and unfortunately often does not integrate risk or effectively collaborate on its management. Defining clear roles and responsibilities for cyber risk is crucial.

Outdated laws and regulations inhibit governments' ability to capture criminals but also to expedite the often lengthy procedure of elaborating and implementing legal and regulatory frameworks to reflect evolving realities. The sophisticated threats of government-sponsored economic espionage also exceed the defensive capabilities of many commercial enterprises, which are more and more frequently looking to other governments to intervene. The G-20 recently took an unexpected, but applauded, step and collectively affirmed "that no country should conduct or support ICT-enabled theft of intellectual property, including trade secrets or other confidential business information, with the intent of providing competitive advantages to companies or commercial sectors."[58]

Businesses are increasingly accepting the fact that they cannot hope to prevent all cyberattacks. The difficulty in preventing attacks is not outmatched by the difficulty in identifying and effectively mitigating them. Given the types of vulnerabilities utilized by attackers and their methods, many attacks and intrusions are not immediately discovered – some are recognized only months and in some cases years later. The emphasis needs to be on streamlining mechanisms for early detection, response and recovery, to mitigate and better manage the consequences – limiting the damage, and ensuring business continuity.

It is also becoming clearer that cybercrime cannot be fought unilaterally. Although businesses can follow standard industry practices or adopt individually tailored ways to deal with cybercrimes, cooperation throughout the value chain (because attacks can be made through supplier systems) and with law enforcement is also helpful, As is often the case, however, public-private partnership can be held back by lack of trust and misaligned incentives. Businesses may fear exposing their data and practices to competitors or to law enforcement agencies. And the private sector's primary interest in rapid recovery and continuity of business operations may not align with the public sector's primary interest in apprehending and prosecuting perpetrators. In addition, governments need to balance their investments in cyber offensive weapons and efforts to enhance capabilities for cybersecurity and defence.

Conclusions

Addressing global risks lies beyond the capacity of individual businesses. Businesses need to strengthen their resilience to ensure continued operation and survival in the face of risks. At the same time, the clear role for collaboration among public and private sector actors becomes evident, for example, to develop better cybercrime prevention methods, to establish cybersecurity norms for both governments and industry, and to align international approaches to enforcement and establish industry norms. Above all, it is in the key interest of businesses to find new ways to partner with governments to address global risks. Many risks, ranging from energy security to unemployment, can only be addressed through diverse stakeholders recognizing the need for joint action. Such collaboration requires the identification of key risks and related interests and strong alignment and robust agreement among business and other stakeholders on the need to address them.

Endnotes

[1] The results presented thus far are drawn from the Global Risks Perception Survey; the results presented here in Part 4 are derived from another survey, the Executive Opinion Survey (see Appendix C).

[2] UNCTAD 2014; UNCTAD 2015.

[3] UNCTAD 2015.

[4] Athukorala and Menon 1997; Baldwin 2011.

[5] Research from the Fukushima event has shown that although just 3% of total companies were directly affected, this figure increased to 50–60% for second-order companies and to 90% for third-order companies. See Saito 2012.

[6] UNCTAD 2015.

[7] Tables 4.1 to 4.8 present a selection of risks that are among the five risks of highest concern in each region (i.e. risk selected based on the highest number of countries in the region in which the risk is among the top five and country-level data are available at www.weforum.org/risks).

[8] Europe includes Albania, Austria, Belgium, Bosnia and Herzegovina, Bulgaria, Croatia, Cyprus, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Macedonia, Malta, the Republic of Moldova, Montenegro, the Netherlands, Norway, Poland, Portugal, Romania, Serbia, the Slovak Republic, Slovenia, Spain, Sweden, Switzerland, Turkey, Ukraine and the United Kingdom.

[9] Unemployment rate for 2015 (IMF estimates): Austria: 5.8%, Finland: 9.5%, France: 10.2%, Greece: 26.8%, Italy: 12.2% and Spain: 26.1%. Retrieved on 22 October 2015 from http://www.imf.org/external/pubs/ft/weo/2015/02/weodata/weorept.aspx?pr.x=66&pr.y=5&sy=2013&ey=2020&scsm=1&ssd=1&sort=country&ds=.&br=1&c=122%2C172%2C132%2C184%2C174%2C136&s=LUR&grp=0&a=

[10] 2013 data are from the World Development Indicators, Unemployment, youth total (% of total labour force ages 15–24) (modelled ILO estimate). Retrieved on 22 October 2015 and available at http://data.worldbank.org/indicator/SL.UEM.1524.ZS

[11] The unemployment rate for 2015 (IMF estimates): Bosnia and Herzegovina: 27% and Serbia: 20.6%. Retrieved on 06 November 2015 from http://www.imf.org/external/pubs/ft/weo/2015/02/weodata/weorept.aspx?pr.x=34&pr.y=3&sy=2013&ey=2020&scsm=1&ssd=1&sort=country&ds=.&br=1&c=943%2C963%2C960%2C942&s=LUR&grp=0&a=

[12] IMF 2015f.

[13] World Bank: Internet users (per 100 people). "Internet users" are individuals who have used the internet (from any location) in the last 12 months. Internet can be used via a computer, mobile phone, personal digital assistant, games machine, digital TV etc. Retrieved on 11 November 2015 from http://data.worldbank.org/indicator/IT.NET.USER.P2?order=wbapi_data_value_2014+wbapi_data_value+wbapi_data_value-last&sort=desc.

[14] World Economic Forum 2015.

[15] Homeland Security Committee 2015.

[16] IMF 2015f.

[17] Central Asia includes Armenia, Azerbaijan, Georgia, Kazakhstan, Kyrgyzstan, the Russian Federation and Tajikistan. See IMF 2015e.

[18] IMF 2015e.

[19] Roaf et al. 2014.

[20] East Asia and the Pacific includes Australia, Cambodia, China, Chinese Taipei, Hong Kong SAR, Indonesia, Japan, the Republic of Korea, Lao People's Democratic Republic, Malaysia, Mongolia, Myanmar, New Zealand, the Philippines, Singapore, Thailand, and Vietnam.

[21] IMF 2015b.

[22] Guha-Sapir, Hoyois, and Below 2014; UNISDR 2015.

[23] South Asia includes Bangladesh, Bhutan, India, Nepal, Pakistan and Sri Lanka.

[24] "Vulnerable employment" is defined by the ILO as "the share of own-account work and contributing family employment, categories of work typically subject to high levels of precariousness"; see ILO 2015.

[25] ILO 2015.

[26] See Transparency International's Corruption Perception Index, 2014 results. Available at http://www.transparency.org/cpi2014/results

[27] Latin America and the Caribbean includes Argentina, Bolivia, Brazil, Chile, Colombia, Costa Rica, the Dominican Republic, Ecuador, El Salvador, Guatemala, Guyana, Haiti, Honduras, Jamaica, Mexico, Nicaragua, Panama, Paraguay, Peru, Trinidad and Tobago, Uruguay and Venezuela.

[28] IMF 2015g.

[29] Middle East and North Africa includes Algeria, Bahrain, Egypt, the Islamic Republic of Iran, Israel, Jordan, Kuwait, Lebanon, Morocco, Oman, Qatar, Saudi Arabia, Tunisia and the United Arab Emirates.

[30] World Development Indicators, World Bank, retrieved 21 October 2015 from http://data.worldbank.org/indicator/SL.UEM.TOTL.ZS/countries

[31] ILO 2015.

[32] UNHCR (The UN Refugee Agency). Facts and Figures about Refugees, available at http://www.unhcr.org.uk/about-us/key-facts-and-figures.html

[33] Kochhar et al. 2015.

[34] Sub-Saharan Africa include Benin, Botswana, Burundi, Cameroon, Cape Verde, Chad, Côte d'Ivoire, Ethiopia, Gabon, Gambia, Ghana, Guinea, Kenya, Lesotho, Liberia, Madagascar, Malawi, Mali, Mauritania, Mauritius, Mozambique, Namibia, Nigeria, Rwanda, Senegal, Seychelles, Sierra Leone, South Africa, Swaziland, Tanzania, Uganda, Zambia and Zimbabwe. See IMF 2015d.

[35] IMF 2015d.

[36] UN DESA 2015.

[37] African Development Bank Group 2011.

[38] Foster and Briceño-Garmendia 2010 was a part of the Africa Infrastructure Country Diagnostic (AICD) project by the World Bank and co-sponsored by ICA partners.

[39] Frey and Osborne 2013.

[40] Adams 2015.

[41] IMF 2015c.

[42] IMF 2015a.

[43] Randall 2014.

[44] The Economist 2014.

[45] WHO 2008.

[46] UNODC 2011.

[47] See the ICC-BASCAP study commissioned by Frontier Economics (Foster Economics 2011).

[48] WTO 2015.

[49] Anderson 2014.

[50] The Economist 2015.

[51] Sizer, Cheung, and Anderson 2014.

[52] Neimark 2015.

[53] BBC News 2015.

[54] Gaither and Chmielewski 2006.

[55] Jones 2015.

[56] McAfee, Inc. 2014.

[57] Fortune Editors 2015.

[58] Cabinet of Prime Minister Trudeau, Canada, 2015.

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Conclusions

The 11th edition of *The Global Risks Report* has explored how global risks are becoming increasingly imminent and materializing in new and sometimes unexpected ways. From climate change to the imperative for improved water governance, from large-scale involuntary migration to reviving growth in the Fourth Industrial Revolution, global risks are affecting the lives of citizens and the functioning of institutions and economies. We now need to move beyond mitigation to adaptation and building resilience. Understanding the drivers of the global security landscape, boosting governance and strengthening policy agility is ever more important. Building a better understanding of how the new security landscape and technological change will impact countries, economies and peoples' lives is, therefore, essential for building sustainable, resilient growth strategies and stable societies.

Global risks remain beyond the domain of just one actor, highlighting the need for collaborative and multistakeholder action – the key message that *The Global Risks Report* series has highlighted over the past decade. Recognizing joint interests and aligning stakeholders on key priorities across the different areas of global risks is the first step to make action through collaboration happen. We hope that this *Report* will contribute to recognizing the need for action, create an imperative towards greater resilience, and motivate change and concrete action towards a better future for everyone.

Appendices

Appendix A: Description of Global Risks and Trends 2016

Global Risks
A "global risk" is defined as an uncertain event or condition that, if it occurs, can cause significant negative impact for several countries or industries within the next 10 years.

	Global Risk	Description
Economic Risks	Asset bubble in a major economy	Unsustainably overpriced assets such as commodities, housing, shares, etc. in a major economy or region.
	Deflation in a major economy	Prolonged ultra-low inflation or deflation in a major economy or region.
	Failure of a major financial mechanism or institution	Collapse of a financial institution and/or malfunctioning of a financial system impacts the global economy.
	Failure/shortfall of critical infrastructure	Failure to adequately invest in, upgrade and secure infrastructure networks (e.g. energy, transportation and communications) leads to pressure or a breakdown with system-wide implications.
	Fiscal crises in key economies	Excessive debt burdens generate sovereign debt crises and/or liquidity crises.
	High structural unemployment or underemployment	A sustained high level of unemployment or underutilization of the productive capacity of the employed population prevents the economy from attaining high levels of employment.
	Illicit trade (e.g. illicit financial flow, tax evasion, human trafficking, organized crime, etc.)	Large-scale activities outside the legal framework such as illicit financial flow, tax evasion, human trafficking, counterfeiting and organized crime undermine social interactions, regional or international collaboration and global growth.
	Severe energy price shock (increase or decrease)	Energy price increases or decreases significantly and places further economic pressures on highly energy-dependent industries and consumers.
	Unmanageable inflation	Unmanageable increase in the general price level of goods and services in key economies.
Environmental Risks	Extreme weather events (e.g. floods, storms, etc.)	Major property, infrastructure and environmental damage as well as human loss caused by extreme weather events.
	Failure of climate-change mitigation and adaptation	Governments and businesses fail to enforce or enact effective measures to mitigate climate change, protect populations and help businesses impacted by climate change to adapt.
	Major biodiversity loss and ecosystem collapse (land or ocean)	Irreversible consequences for the environment, resulting in severely depleted resources for humankind as well as industries.
	Major natural catastrophes (e.g. earthquake, tsunami, volcanic eruption, geomagnetic storms)	Major property, infrastructure and environmental damage as well as human loss caused by geophysical disasters such as earthquakes, volcanic activity, landslides, tsunamis or geomagnetic storms.
	Man-made environmental catastrophes (e.g. oil spill, radioactive contamination, etc.)	Failure to prevent major man-made catastrophes, causing harm to lives, human health, infrastructure, property, economic activity and the environment.

	Global Risk	Description
Geopolitical Risks	Failure of national governance (e.g. failure of rule of law, corruption, political deadlock, etc.)	Inability to govern a nation of geopolitical importance due to weak rule of law, corruption or political deadlock.
	Interstate conflict with regional consequences	A bilateral or multilateral dispute between states escalates into economic (e.g. trade/currency wars, resource nationalization), military, cyber, societal or other conflict.
	Large-scale terrorist attacks	Individuals or non-state groups with political or religious goals successfully inflict large-scale human or material damage.
	State collapse or crisis (e.g. civil conflict, military coup, failed states, etc.)	State collapse of geopolitical importance due to internal violence, regional or global instability, military coup, civil conflict, failed states, etc.
	Weapons of mass destruction	Nuclear, chemical, biological and radiological technologies and materials are deployed creating international crises and potential for significant destruction.
Societal Risks	Failure of urban planning	Poorly planned cities, urban sprawl and associated infrastructure create social, environmental and health challenges.
	Food crises	Access to appropriate quantities and quality of food and nutrition becomes inadequate, unaffordable or unreliable on a major scale.
	Large-scale involuntary migration	Large-scale involuntary migration induced by conflict, disasters, environmental or economic reasons.
	Profound social instability	Major social movements or protests (e.g. street riots, social unrest, etc.) disrupt political or social stability, negatively impacting populations and economic activity.
	Rapid and massive spread of infectious diseases	Bacteria, viruses, parasites or fungi cause uncontrolled spread of infectious diseases (for instance due to resistance to antibiotics, antivirals and other treatments) leading to widespread fatalities and economic disruption.
	Water crises	A significant decline in the available quality and quantity of fresh water resulting in harmful effects on human health and/or economic activity.
Technological Risks	Adverse consequences of technological advances	Intended or unintended adverse consequences of technological advances such as artificial intelligence, geo-engineering and synthetic biology causing human, environmental and economic damage.
	Breakdown of critical information infrastructure and networks	Cyber dependency increases vulnerability to outage of critical information infrastructure (e.g. internet, satellites, etc.) and networks causing widespread disruption.
	Large-scale cyberattacks	Large-scale cyberattacks or malware causing large economic damages, geopolitical tensions or widespread loss of trust in the Internet.
	Massive incident of data fraud/theft	Wrongful exploitation of private or official data that takes place on an unprecedented scale.

Trends

A "trend" is defined as a long-term pattern that is currently taking place and that could contribute to amplifying global risks and/or altering the relationship between them.

Trend	Description
Ageing population	Ageing populations in developed and developing countries driven by declining fertility and decrease of middle and old age mortality.
Changing landscape of international governance	Changing landscape of global or regional institutions (e.g. UN, IMF, NATO, etc.), agreements or networks.
Climate change	Change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere, in addition to natural climate variability.
Environmental degradation	Deterioration in the quality of air, soil and water from ambient concentrations of pollutants and other activities and processes.
Growing middle class in emerging economies	Growing share of population reaching middle-class income levels in emerging economies.
Increasing national sentiment	Increasing national sentiment among populations and political leaders affecting countries' national and international political positions.
Increasing polarization of societies	Inability to reach agreement on key issues within countries because of diverging or extreme values, political or religious views.
Rise of chronic diseases	Increasing rates of non-communicable diseases, also known as chronic diseases, leading to long-term costs of treatment and threatening recent societal gains in life expectancy and quality.
Rise of cyber dependency	Rise of cyber dependency due to increasing digital interconnection of people, things and organizations.
Rising geographic mobility	Increasing mobility of people and things due to quicker and better-performing means of transport and lowered regulatory barriers.
Rising income and wealth disparity	Increasing socio-economic gap between rich and poor in major countries or regions.
Shifts in power	Shifting power from state to non-state actors and individuals, from global to regional levels, and from developed to emerging market and developing economies.
Urbanization	Rising number of people living in urban areas resulting in physical growth of cities.

Appendix B: Global Risks Perception Survey and Methodology 2015

Definitions

The Global Risks Report 2016 is based on the same methodology adopted in the previous year and results are therefore largely comparable. The *Report* adopts the following definitions of global risk and trend:

Global risk: an uncertain event or condition that, if it occurs, can cause significant negative impact for several countries or industries within the next 10 years.

Trend: a long-term pattern that is currently taking place and that could contribute to amplifying global risks and/or altering the relationship between them.

The list of risks and trends assessed in the Global Risks Perception Surveys has changed slightly. The risk "Illicit trade" was extracted from the risk "Failure of national governance" to create another risk in the economic category. Moreover, the risk "Massive and widespread misuse of technologies (e.g. 3D printing, artificial intelligence, geo-engineering, synthetic biology, etc.) was reformulated into the risk "Adverse consequence of technological advances". The definition of each risk also went through a review process.

The following section describes the survey and methodology in greater detail.

The Global Risks Perceptions Survey

The Global Risks Perception Survey (GRPS), discussed in Part 1, is the main instrument used to assess global risks in this *Report*. The survey was conducted between mid-September and the end of October 2015 among the World Economic Forum's multistakeholder communities of leaders from business, government, academia and non-governmental and international organizations.

Raw responses were cleaned in order to improve overall data quality and completeness. All questionnaires with a completion rate below 50% were dropped, reducing the number of available responses from 933 to 742. The respondents did not provide any information about their gender or the sector in 3 and 49 cases, respectively, but it was possible to infer this information from the rest of the records provided for the gender and for 39 cases for the sector. Similarly, 92 respondents did not indicate the region in which they are based and 77 were manually assigned to a region on the basis of their country of residence.

Figure B.1 presents the profile of the 742 survey respondents remaining in the sample. To capture the voice of youth, the survey also targeted the World Economic Forum's community of Global Shapers.[1] Respondents under 30 accounted for slightly more than one-fourth of total respondents.

Figure B.1: Survey Sample Composition

Source: Global Risks Perception Survey 2015.
Note: Reported shares are based on number of valid responses: Gender: 742 responses; Expertise: 726; Organization type: 732; Age distribution: 742; Region: 727.

Analysis

The Global Risks Landscape 2016 (Figure 1)

Respondents were asked to assess the likelihood and global impact of each of the 29 risks. For each risk, they were asked, "How likely is this risk to occur globally within the next 10 years?" and "What is the estimated impact globally if this risk were to materialize? (Impact is to be interpreted in a broad sense beyond just economic consequences)". The possible answers ranged from 1 ("very unlikely" and "low" impact, respectively) to 7 ("very likely" and "high" impact, respectively).

Respondents were given the possibility to choose a "Don't know" option if they felt unable to provide an informed answer. Respondents could also leave the question completely blank. For each risk, partial responses, i.e. those assessing only the likelihood or only the impact, were dropped. A simple average for both likelihood and impact for each of the 29 global risks was calculated on this basis. Formally, for any given risk *i*, its likelihood and impact, denoted respectively $likelihood_i$ and $impact_i$, are:

$$likelihood_i = \frac{1}{N_i}\sum_{n=1}^{N_i^1} likelihood_{i,n}$$

$$impact_i = \frac{1}{N_i}\sum_{n=1}^{N_i^2} impact_{i,n}$$

where N_i is the number of respondents for risk *i*, and $likelihood_{i,n}$ and $impact_{i,n}$ are respectively the likelihood and impact assigned by respondent *n* to risk *i* and measured on a scale from 1 to 7. N_i is the number of respondents for risk *i* who assessed both the likelihood and impact of that risk.

The Global Risks Interconnections Map 2016 (Figure 2) and The Risks-Trends Interconnections Map 2016 (Figure 4)

To draw the Global Risks Interconnections Map in Part 1, survey respondents were asked to answer the following question: "In your view, which are the most **strongly connected** risks? Please select at least three pairs and up to six pairs from the 29 risks below (one risk can be connected to any one of the other 28 risks)".

Similarly, for the Risks-Trends Interconnections Map 2016 respondents had to identify up to three trends that they consider important in shaping the global agenda in the next 10 years and the three risks that are driven by each of those trends. For completeness, the two questions read "From the list of trends below, which are the three most important trends that will shape global development in the next 10 years"; and "For each of the three trends identified in [the previous question], select up to three risks from the list below that are most strongly driven by these trends". The information thereby obtained was used to construct the Risks-Trend Interconnections Map 2016.

In both cases, a tally was made of the number of times each pair was cited. This value was then divided by the count of the most frequently cited pair. As a final step, the square root of this ratio was taken to dampen the long-tail effect (i.e. a few very strong links, and many weak ones) and to make the differences more apparent across the weakest connections. Out of the 406 possible pairs of risks, 167 or 41% were not cited. Similarly, out of the possible 377 trend-risk combinations, 33 or 9% were not cited. Formally, the intensity of the interconnection between risks *i* and *j* (or between trend *i* and risk *j*), denoted $interconnection_{ij}$, corresponds to:

$$interconnection_{ij} = \sqrt{\frac{\sum_{n=1}^{N} pair_{ij,n}}{pair_{max}}}$$

$$pair_{max} = \max_{ij}\left(\sum_{n=1}^{N} pair_{ij,n}\right)$$

where *N* is the number of respondents.

Variable $pair_{ij,n}$ is 1 when respondent *n* selected the pair of risks *i* and *j* as part of his/her selection. Otherwise, it is 0. The value of the interconnection determines the thickness of each connecting line in the graph, with the most frequently cited pair having the thickest line.

In the Global Risks Landscape and Risks-Trends Interconnections Maps, the size of each risk is scaled according to the "weighted degree" of that node in the system. Moreover, in the Risks-Trends Interconnections Map, the size of the trend represents the perception of its importance in shaping global development (answer to the first part of the question on trend as explained above); the biggest trend is the one considered to be the most important in shaping global development.

The placement of the nodes in the Global Risks-Trends Interconnections Map was computed using ForceAtlas2, a force-directed network layout algorithm implemented in Gephi software, which minimizes edge lengths and edge crossings by running a physical particle simulation.[2]

Global Risks of Highest Concern in 2016 (Figure 1.2)

Although the *Report* generally looks at global risks on a time horizon of 10 years, respondents were asked to identify the risks of highest concern within two different timeframes: 18 months and 10 years. To identify the top five global risks of highest concern described in Part 1, respondents answered the following question: "In this survey, we are looking at risks within the next 10 years. For this question only, please select the five global risks that you believe to be of most concern within the next 18 months and 10 years, respectively".

For any given risk *i* from the list of 29 risks, we obtained the share of total respondents (N = 742) that have declared to be concerned about that risk:

$$\%\ concern_i = \frac{1}{N}\sum_{n=1}^{N}(c_{i,n})$$

with $c_{i,n} \in \{0,1\}$ and equal to 1 if respondent *N* selected risk *i* as a risk of concern. The risks with the five highest shares were selected as the risks of most concern.

The Most Likely Global Risks 2016: A Regional Perspective (Figure 3)

In the survey, respondents were asked to identify up to three risks that were the most likely to occur in the region in which they are based.[3]

For any given risk *i* from the list of 29 risks, we obtained the share of respondents from region *r* (N_r) who think that risk *i* is the most likely to occur in their region:

$$\%\ likelihood_{ir} = \frac{1}{N_r}\sum_{n=1}^{N_r}(l_{i,n})$$

with $l_{i,n} \in \{0,1\}$ and equal to 1 if respondent *N* selected risk *i*.

Appendix C: The Executive and Opinion Survey 2015: Views of the Business Community on the Global Risks of Highest Concern for Doing Business

Every year since 1979 the World Economic Forum has conducted the Executive Opinion Survey (EOS). This survey captures invaluable information on a broad range of socio-economic issues. In the 2015 edition, over 13,000 executives in 140 economies were surveyed.[4]

The 2015 edition of the EOS, conducted between February and June 2015, included a question on the risks of highest concern for the second time. More specifically, respondents were asked to select the five global risks that they believe to be of most concern for doing business in *their country* within the next 10 years.

The list of 28 global risks presented in the EOS is derived from the list of global risks of *The Global Risks Report 2015* and is almost similar to the global risks of *The Global Risks Report 2016* (see Appendix B for the differences in global risks between the two editions). The size and nature of the EOS and the GRPS respondents differed significantly: they comprised a multistakeholder group of experts in the case of the GRPS and business executives in the case of the EOS. The EOS results provide a complementary perspective – that of businesses on the impact of global risks on their businesses.

Formally, for each country *j* the share of respondents selecting each global risk *i* is:

$$\% \, C_{ij} = \frac{1}{N_r} \sum_{n=1}^{N_j} (c_{i,n})$$

where N_j is the sample size of the country *j* and $n_{i,j}$ is the number of respondents who selected the risk *i* in their five global risks of highest concern for doing business in country *j*. $C_{i,j}$ is the share of respondents who selected risk *i* in country *j*.

Interested readers can visit the portal at http://wef.ch/risks2016 to access the results for individual economies and regions.

Endnotes

[1] The Global Shapers Community is a network of hubs developed and led by young people who are exceptional in their potential, achievement and drive to make a contribution to their communities; see http://www.weforum.org/community/global-shapers
[2] 3 See Jacomy et al. 2012.
[3] Respondents indicated the region in which they were based from the following list: Europe, Central Asia including Russia, East Asia and Pacific, South Asia, Sub-Saharan Africa, Middle-East and North Africa, Latin America and the Caribbean, North America, and Oceania.
[4] For more information about the Survey, see Browne et al. 2014.

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Organization for Security and Cooperation in Europe (OSCE); Almira Zejnilagic, FTI Consulting; Lassina Zerbo, Preparatory Commission for the Comprehensive Nuclear-Test-Ban Treaty Organization; and Daniel Zovatto, International Institute for Democracy and Electoral Assistance.

Figure: Scenarios Methodology, Workshops' Composition

Note: In total, the 10 workshops gathered 281 experts

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