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ADVANTAGE

INTRODUCTION

The infrastructure sector faces a complex landscape of global risks in 2020. Against a backdrop of macroeconomic uncertainty, societal instability, weaponized cyber capabilities, acute environmental threats and geopolitical frictions, infrastructure investors will need to be adaptable to ensure the longevity and security of their assets. Doing so will require a textured understanding of the types of global risks the infrastructure sector faces in 2020, as well as their potential impacts. The 2020 Global Risks for Infrastructure Map, produced by Marsh & McLennan Advantage Insights in partnership with the Global Infrastructure Investor Association (GIIA), provides some guidance for investors looking to navigate the choppy waters ahead.

The Map draws on data from the Global Risks Report (GRR), a report published by the World Economic Forum (WEF) with support from Marsh & McLennan. Using the GRR's Executive Opinion Survey (EOS), in which 12,879 business executives from 133 economies ranked the top global risks of doing business in their respective markets, Marsh & McLennan has identified nineteen key risk types out of the Global Risks Report's thirty global risks that pose direct and material risks to infrastructure assets in key markets [1] (see Section 1). Each risk has been presented with a case study exploring the unique challenges these risks pose to infrastructure assets in the developed world (see Section 2). These case studies have been carefully selected from key markets whose top business leaders have expressed high levels of concern over the global threats looming on the   horizon.

To provide infrastructure investors with an even broader view of these risks, four case studies demonstrating their interconnectedness have also been included (see Section 3). These case studies have been presented on a diagram illustrating the interconnections between today's global risks, which draws on data from the GRR's Global Risks Perception Survey (GRPS). Taken from around the world, the first two case

1. "Key markets" comprise economies categorized by the IMF as "Advanced Economies" with a billion US$20 minal GDP as of 2017, and the top 25 economies by forecasted infrastructure investment between 2016-2040 as projected by the G-Hub) (July 2017)

TABLES OF CONTENTS

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RISK
TAXONOMY

Risk types and definitions

Global Risks for Infrastructure

Economic	Societal			

Economic

Critical
Ec111 6021112m aET2EpIGr8iAgifact <</O /Layout >>BDC 8742/TT47.3 Td72 1 T7350 m9113138

Societal

Failure of urban

Social instability

Water crises

Global

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RISK
PROFILES

Markets at risk & case   studies

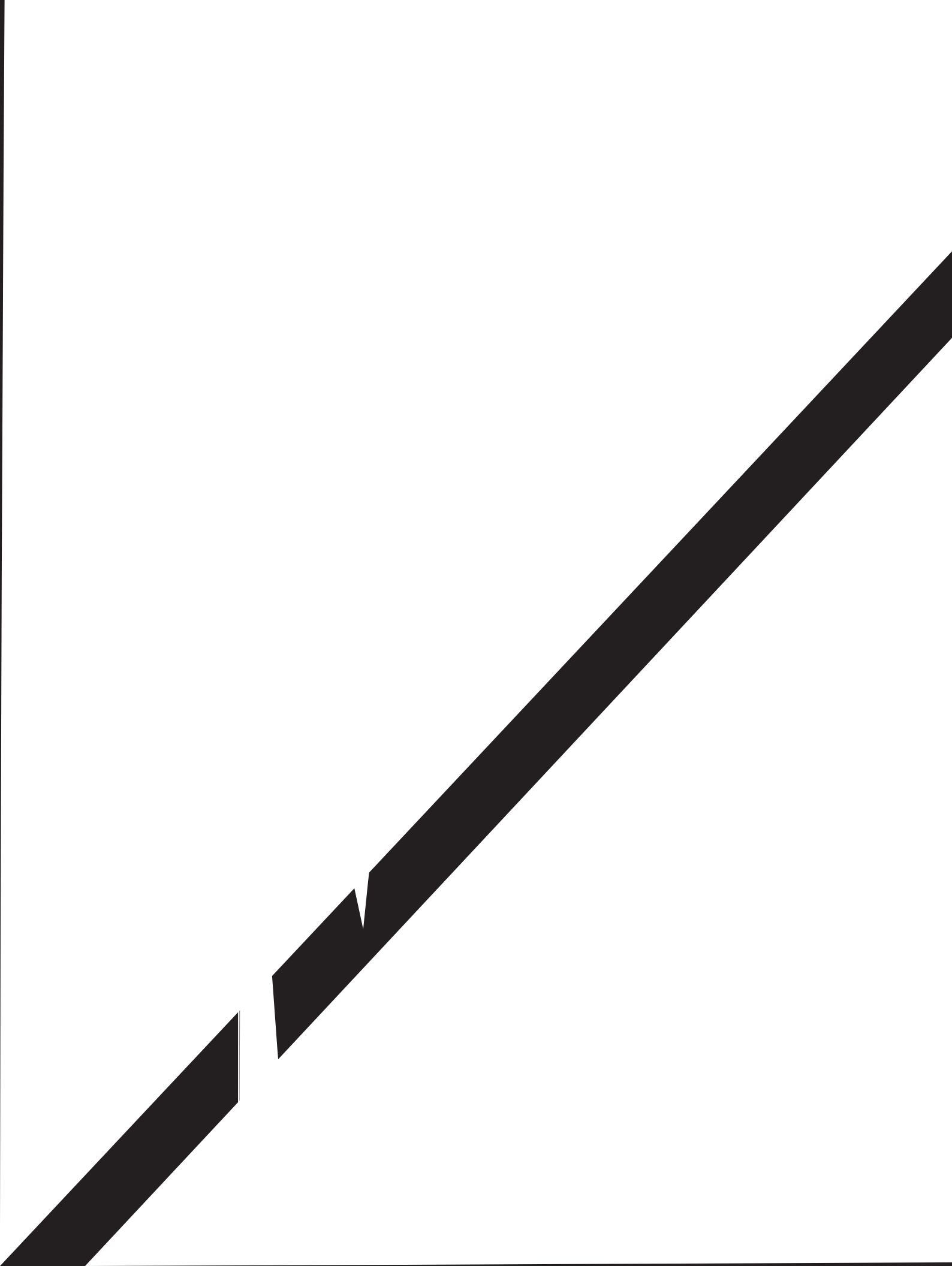- Economic risks
- Societal risks
- Technological risks
- Environmental   risks
- Geopolitical risks

ECONOMIC RISKS

ECONOMIC

ENERGY PRICE SHOCK

Significant energy price increases or decreases that place further economic pressures on highly energy-dependent industries and   consumers.

ECONOMRISKS

Selected markets at   risk [1]
Australia – Spain – Sweden – Taiwan

Case study: Australia

Severe energy price hikes in Australia have limited growth in the infrastructure sector, where volatile energy prices have affected long-term contracts and threatened project bankability. Research out of the University of Sydney shows that by 2018, Australian energy prices in real terms had increased by 7   0% on average since 2008 – making it one of the world's most expensive markets for energy. This steady rise has also been punctuated by discrete shocks that have e r66 238Hoft of

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.

Selected markets at   risk [1]

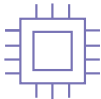India – Philippines – Singapore

ADVERSE TECHNOLOGICAL ADVANCES

TECHNOLOGICAL

TECHNOLOGICAL TASKS

DATA
FRAUD

TECHNOLOGICAL RISKS

CLIMATE ACTION FAILURE

The failure of governments and businesses to enforce or enact effective measures to mitigate climate change, protect populations and help businesses impacted by climate change to   adapt.

Selected markets at   risk [1]

Finland – Ireland – Netherlands – Sweden

ENVIRONMENT RISKS

Case study: Netherlands

The Netherlands is a global pioneer in adopting innovative infrastructural adaptations to mitigate the negative impacts of climate change, and is compelled to do so because of its intrinsic geographical challenges. Roughly a third of the country lies below sea level and continues to sink further, making it one of the most vulnerable nations to climate change. In November 2018, the Dutch government pledged to invest €600 million in climate adaptation innovations, on top of the existing €1.3 billion a year on the Delta Plan

NATURAL DISASTERS

Major property, infrastructure, and/or environmental damage as well as loss of human life caused by geophysical disasters such as earthquakes or landslides.

Selected markets at risk [1]
Iceland – Japan – New Zealand – Philippines

ENVIRONMENT RISKS

Case study: New Zealand

The 7.8 magnitude Kaikoura earthquake devasted New Zealand in 2016. The earthquake severely damaged infrastructure across the country, including roads, railways and ports, triggering additional side effects such as landslides and tsunamis.

The post-disaster damage came to businesses in the form of both insurance claims and lost revenue. Over NZD$1.8 billion in insurance claims were reported after the incident, out of which NZD$1.4 billion originated from the commercial sector according to the Insurance Council. In the Kaikoura region – the epicentre of the earthquake – the utility, construction and transportation sectors lost 34% of their operability (i.e. of their normal productive capacity) within the first week of the disaster. New Zealand, which lies on a seismically active zone along the Pacific Ring of Fire, continues to be at risk of earthquakes and other associated natural disasters – and infrastructure is at the forefront of such risks.

1. As per WEF EOS data

HUMAN-MADE ENVIRONMENTAL DISASTER

Failure to prevent major man-made damage and disasters, including environmental crime, causing harm to human lives and health, infrastructure, property, economic activity and the   environment.

Selected markets at   risk [1]
India – Italy – South Korea

Case study: South   Korea

In July 2018, the Xe Pian-Xe Namnoy dam in Laos's Champasak province collapsed, flooding downstream villages, displacing at least 6,000 people. The project, part of a regional US$1 billion dam system, was jointly funded and developed by two private Laotian entities and two South Korean companies. Shortly after the disaster, the Lao Ministry of Energy and Mines released statements on construction standards and accelerated project timelines as potential causes. Other independent analyses   have also identified dam design and material selection as plausible contributing   factors.

In response, both of the Korean companies involved committed a combined US$11 million in relief efforts. They also suffered significant financial hits, with one company seeing a 30% plunge in stock prices. Social backlash additionally posed potential reputational regulatory and legal risks for relevant stakeholders, as Korean civil society groups implored   their government to disclose information and conduct independent   investigations.

1. As per WEF EOSdata

ENVIRONMENTRISKS

NATIONAL OR GLOBAL

GEOPOLITICAL RISKS

INTERSTATE CONFLICT

A bilateral or multilateral dispute between states that escalates into economic, military, cyber, societal, or other   conflict.

Selected markets at   risk [1]
France – Japan – Switzerland – Taiwan

GEOPOLITICRISKS

Case study: Japan

Today's geopolitical climate means that interstate conflict has the potential to turn "hot", i.e. to lead to actual military confrontation. These developments can result in severe physical damage to infrastructure assets exposed to battle zones, as well as revenue loss or process disruption from blockades or occupation.

Interstate conflicts can also manifest as economic tensions that bite into revenues for trade-

TERRORIST ATTACKS

Individuals or non-state groups with political or religious goals that successfully inflict large-scale human or material   damage.

Selected markets at   risk [1]
Germany – Singapore – U.K. – USA

GEOPOLITIC RISKS

Case study: U.K.

Transportation systems are the world's most heavily-targeted infrastructure sector for terrorist attacks according to the   Global Terrorism Database . Between 2000 and 2018, transportation systems faced higher numbers of terror attacks than water systems, utilities, telecommunications, or airports and aircraft systems globally. The United Kingdom is no exception: the country's transportation system saw 28 terror attacks in this period, compared with   8 terror attacks on all other forms of infrastructure   combined.

The destabilizing effects of frequent terror attacks have had particularly important impacts on London's underground railway system. Research shows that after the 7/7 bombings across London's public transport systems in 2005, passenger journeys on the London Underground   fell by an average of 8.3% for the following   4 months. In 2017, passenger numbers fell in 2017 for the first time in 20 years – in part, the railway operator and experts concluded, due to fears of terror . Transport for London (or TfL)'s spending programs on safety and collaboration with authorities will be instrumental in protecting against losses to human life and restoring the public's confidence in this critical infrastructure   system.

1. As per WEF EOS data

GEOPOLITIC RISKS

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INTER-CONNECTIONS

Case studies on interconnected   risks

Extreme Weather in   Chennai
A confluence of varied risk drivers exacerbate extreme weather   impacts

Business Damages in Eastern   Europe
A confluence of emerging social and political risks drive investor   concerns
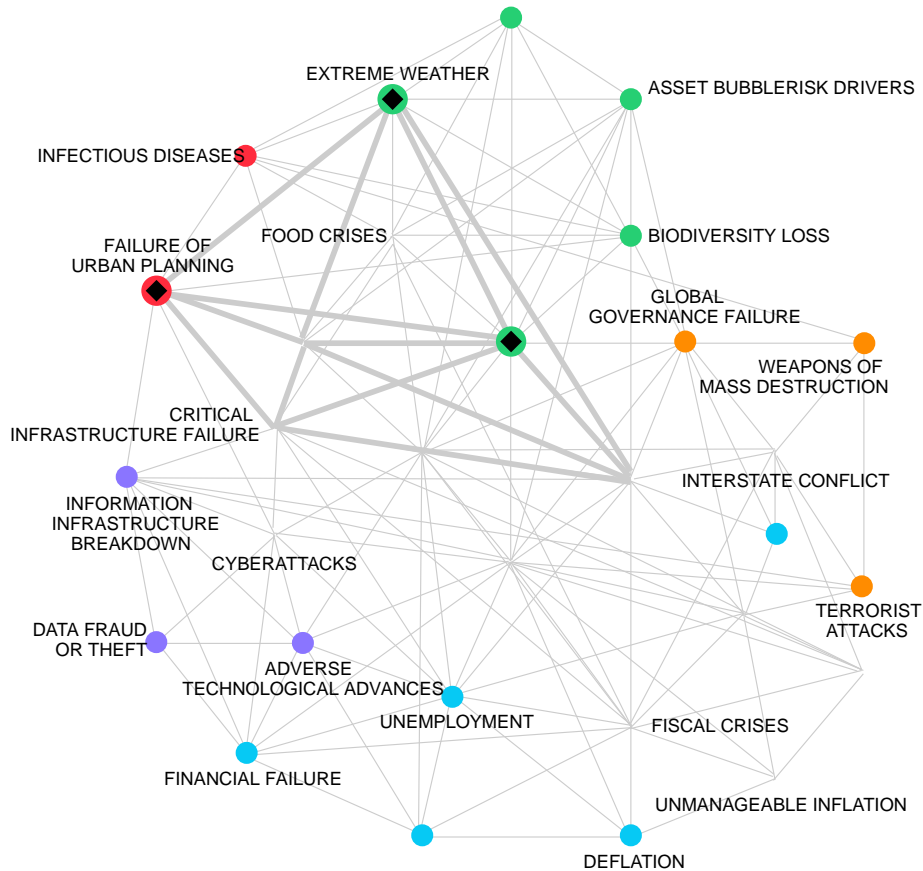and a critical infrastructure   failure

The Fukushima   Disaster
A natural disaster catalyzes a variety of impacts for the domestic   energy
sector and beyond

Cyberattack on a Water   Utility
Geopolitical incidents catalyze a series of knock-on events for a water   utility ,
including hacktivism and risks to public   health

EXTREME WEATHER CHENNAI

The Indian city of Chennai frequently suffers damage from extreme weather: particularly from severe water shortages as well as unmanageable flooding. This has been attributed in part to uncontrolled urban growth after the city began to actively attract IT-sector companies and talent in 2008, resulting in significant encroachment onto the city's water bodies and natural drainage systems. This failure of urban planning and of climate-change mitigation and adaptation has increased the damage the city sustains when extreme weather strikes. Chennai's local government has also been slow to curb the power of the city's local "water mafias", who charge extortive water prices in difficult times. This failure of national governance has also been raised as a factor behind the government's inaction over infrastructure development and resilience-building against extreme weather.

As a result, in 2015, when the city was inundated by its heaviest rainfall in over 100 years, over a million residents were displaced from their homes and the city was disrupted for days. In 2018 Chennai's rainfall fell by 55%, leaving the city without rainfall for 200 days and scrambling for water supplies. These water crises and the failure of the city's critical infrastructure to manage them have occurred recurrently in recent years, and have also affected infrastructure operators across sectors. Major power distributor Tangedco lost nearly US$140 million each year between 2015-2018 due to flood damages, and in 2017, the major 1050MW Tuticorin thermal plant was temporarily shut down due to a lack of water for cooling. Additionally, Chennai's water shortages in 2018 caused companies across industries to pay as much as 30% more for private water supplies.

3. Interconnections

In 2011, three nuclear cores at the now-famous Fukushima Daiichi power plant in Japan melted when a 14-meters high tsunami, triggered by a magnitude 9.1 earthquake, inundated the plant. This natural disaster and the subsequent failure of the critical Fukushima power plant resulted in the involuntary evacuation of 100,000 people, and contaminated food and water resources in the prefecture – giving rise to lawsuits against the company responsible and pressures on other surrounding infrastructure companies reliant on stable populations and water resources.

Japan still feels the impact of Fukushima today. By 2012, the government had moved quickly to enact the sweeping denuclearization of the Japanese energy sector. The policy reform meant the loss of 30% of the country's energy-generating capacity, and thus increased reliance on oil and gas imports, exposing the Japanese economy to external energy price shocks . The financial burden on the Japanese government has also been significant: a 2019 estimate forecasts that the government could take on over US$560 billion in recovery -US0pan <<. 1/og72g /GS0 gs4f

In March 2016, Verizon's monthly security breach publication drew widespread attention to a cyberattack on a major unnamed water utility. The hack was suspected to have been administered by a "hacktivist" group with motivations relating to the ongoing Interstate conflict in Syria. The system in question ran on operating systems from over a decade prior, leaving it particularly vulnerable to such an attack.

The attack gave rise to a number of related risks

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DATA APPENDIX

Top 5 risks to doing business by economy

RISK BY

4. Data appendix

Greece | Fiscal crises | Financial failure | Failure of national governance |

Ireland

Failure of urban

Israel

Terrorist attacks

Cyberattacks
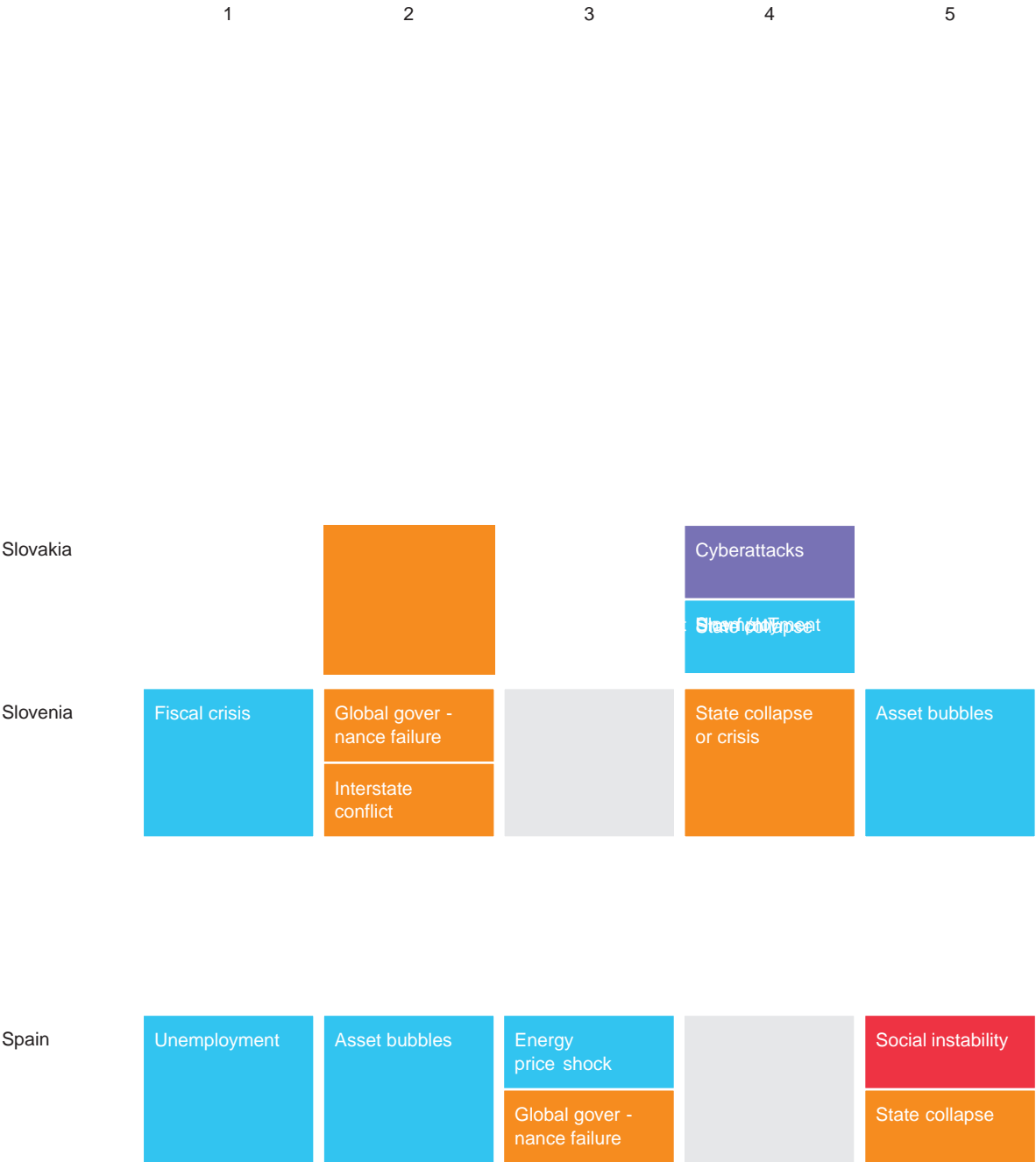
Interstate
F R Q Š L F W

Weapons of
mass destruction

Asset bubbles

Failure of
urban planning

RISK BY MARKET

	1	2	3	4	5
Mexico	National governance failure	Illicit trade		Energy price shock	State collapse or crisis
Netherlands	Cyberattacks	Asset bubbles / Data fraud or theft		Climate action failure	Terrorist attacks / Unemployment
New Zealand	Natural disasters	Cyberattacks	Critical infrastructure failure	Failure of urban planning	-6Q68 0 0.76 0 k 5
Norway	Extreme weather	Data fraud or theft	Involuntary migration	Information infrastr. breakdown / Cyberattacks / Energy price shock / Financial failure	

RISK BY MARKET

	1	2	3	4	5
Slovakia				Cyberattacks / State collapse / Unemployment	
Slovenia	Fiscal crisis	Global gover - nance failure / Interstate conflict		State collapse or crisis	Asset bubbles
Spain	Unemployment	Asset bubbles	Energy price shock / Global gover - nance failure		Social instability / State collapse

RISK BY MARKET

	1	2	3	4	5
Sweden	Cyberattacks	Interstate F R Q Š L F W	Asset bubbles	Data fraud or theft / Involuntary migration / Unemployment	
Switzerland	Cyberattacks	Data fraud or theft	National governance failure	Terrorist attacks	Adverse technological advances
Taiwan	Interstate F R Q Š L F W	Energy price shock	Asset bubbles	Cyberattacks	Global governance failure
Turkey	Fiscal crisis	Interstate F R Q Š L F W	Unmanageable L Q Š D W L R Q	National governance failure	Unemployment
United Kingdom	Cyberattacks	Data fraud or theft	National governance failure	Terrorist attacks	Adverse technological advances
United States	Cyberattacks	Data fraud or theft	Terrorist attacks	Information infrastructure breakdown	Critical infrastructure failure
Vietnam	Asset bubbles / Failure of urban planning		Unemployment	Fiscal crisis	National governance failure / Illicit trade / Unmanageable inflation

Technological ● Environmental ● Geopolitical