Cambridge Centre for Risk Studies

Cambridge Global Risk Framework

MULTI-THREAT RISK ANALYSIS AND INSURANCE GROWTH OPPORTUNITES

Centre for **Risk Studies**

UNIVERSITY OF CAMBRIDGE
Judge Business School

AIG

The Cambridge Global Risk Index aims to measure the global risk outlook from 22 threats across 300 cities. Wide streams of research across multiple disciplines are required to power the creation of the Cambridge Global Risk Index. Cambridge Centre for Risk Studies acknowledges the generous support provided for this research by the following organisations:

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Contents

Section 1: **Introduction**

Cities drive the global economy and insurance market, and yet their high concentrations of physical, financial, digital and human capital make them vulnerable to myriad risks from both natural and man-made threats. These risks are evolving in response to changes in the threat landscape, economic growth dynamics, and mitigation efforts aimed at building resilience.

Not all cities are equally prepared to deal with these risks however. City insurance penetration – a key factor of overall resilience, measuring premium as a share of economic output – varies enormously, with emerging city economies often managing only a fraction of the penetration levels found in more advanced cities. There are two major implications for cities facing high threat levels but at different insurance penetration levels: those with lower penetration levels will see their direct threat damages translate into much higher losses in future economic output; yet those same cities with currently low penetration present promising growth opportunities for insurers if products can be aligned with city-specific threat landscapes.

There are many factors influencing the uptake of insurance in any city, from the state of economic development to regulatory regimes to even the risk perception of senior management in city businesses. As such, traditional product offerings and investments in servicing insurance markets, particularly in emerging economies, have not always reflected the actual risks facing different regions and cities. Matching insurance products to the risk profile of local markets is critical for increasing insurance uptake and the realisation of this situation can be helped through the development of analytical tools. This report addresses three main questions related to this process.

What risks do cities face?

Section 2 of this report summarises the Cambridge Global Risk Index for 2017 – the Cambridge Centre for Risk Studies' analysis of the risk to 300 of the world's leading cities from 22 threats in five broad categories. This index provides a measure of the annual expected loss share of economic output for each city. Estimates of expected loss are composites of all of the probabilities and consequences of thousands of simulated city- and threat-specific shock scenarios. These differ from alternative approaches based on statistical analysis of historical events on the premise that at the city-level too few real events can be found, particularly for emerging threats. Taipei is estimated to have the highest expected loss at $20.6 bn, closely followed by Tokyo at $20.4 bn, while war-torn cities including Damascus, Baghdad, and Kabul are estimated to have the highest expected loss share of economic output at 11.5%, 10.1% and 9.9%, respectively.

How do city risks relate to insurance penetration levels?

A simple methodological approach is presented in Section 3 that estimates city non-life insurance penetration levels using country insurance data and both country and city economic data. While there are many country factors influencing penetration levels, the method assumes that, within a country, city levels are proportional to output per capita. City penetration levels are then compared to risks in the form of expected loss across five threat categories drawn from the Cambridge Global Risk Index. The general trend is high insurance penetration for relatively low expected loss (less than 1%), corresponding to more advanced city economies, and low insurance penetration for relatively high expected loss (greater than 1%), corresponding to emerging city economies. This trend is notably reversed for technology and space threats, with more advanced city economies at high penetration levels being associated with relatively higher expected losses.

How can insurance products be aligned with city risk profiles and identify insurance growth opportunities?

Finally, in Section 4 a prototype framework is laid out to illustrate how insurers could align insurance product offerings with the risks facing different cities. The framework consists of an indicative mapping of impact to exposure types, e.g., physical damage, from different threat types and ultimately likely losses across different insurance lines. This map can then be used to link a city's risk profile to likely insurance line opportunities, on the assumption that where there is risk there is also the potential demand for insurance. Opportunities are identified by combining the risk-driven product alignment approach with estimates of current insurance penetration and regional market growth expectations, with low penetration levels in regions with high growth

expectations offering the greatest overall opportunity. Six sample cities, facing diverse threats and levels of insurance penetration, are used to help illustrate the framework.

The analytical approaches summarised in this report provide a promising step in the direction of developing robust tools that can support both insurers in their pursuit of new opportunities and cities in their efforts to efficiently build resilience to the threats they face.

Section 2: **Cambridge Global Risk Index 2017**

The risk of major shocks to the global economy is increasing. Over the next three years, the estimates suggest that risk will be significantly elevated over its long-term baseline.

The baseline itself – a ten-year projection – is trending upwards. Our Global Risk Index of probability-weighted losses from 22 different types of shocks to 300 of the world's leading cities is estimated to be 1.48% of annual global economic output. Between 2017-19, the Index is estimated to be elevated above the ten-year baseline at around 1.51% of annual GDP. With nominal GDP for 2017 forecast to reach around $77.7 trillion, the Global Risk Index of 1.51% means an expected loss of $1.17 trillion.

This increase in global risk is driven by various forces. Firstly, the world's economy is growing, meaning that there is more output to be disrupted. Secondly, geopolitical risks are increasing, technology risks are proliferating, and some types of financial crises are more likely now than they have been since the recovery from the Great Financial Crisis.

Other threat-types are reducing: pandemic risk and banking crisis contagion are being managed downwards, and violent political separatism is becoming less common. Natural catastrophes and climatic disasters are expected to continue to occur at close to their historical frequency, although impacts of climate change remain a major driver of anticipated future increases in the frequency and severity of several meteorological threats.

This section summarises the Cambridge Centre for Risk Studies' analysis of global risk outlook for 2017 to the world's economy from 22 threats in five broad categories. In the development of this outlook, available evidence and data on the development and spread of these threats is gathered to estimate the potential impact on city economies by generating city-level scenarios, thus providing a unique tool for assessing future risks.

As the world's trading networks become more interconnected, shocks in one place create consequences in many other parts of the world, affecting supply chains, customers, investors, and counterparts elsewhere. The impact of a shock that occurs today is more widespread and costly than a decade ago.

The last Cambridge Centre for Risk Studies' Global Risk Index analysis was produced in 2014 in partnership with Lloyd's as the ten-year outlook Lloyd's City Risk Index 2015-2024. In that analysis it was estimated that 1.46% of global GDP was at risk over the next decade. In addition to revising the ten-year outlook for 2017 to 2026 as a baseline view, the new Index also analyses a shorter term three-year outlook from 2017 to 2019 to identify risks which might be elevated above their long-term baseline. For consistency, all results are shown as a one-year average expected loss index.

How we analyse risk

We analyse the risk to 300 of the world's leading cities, responsible for half of global GDP, and consider a wide range of potential causes of future shocks by modelling around 12,000 scenarios. Economic shock models have been developed for 22 different threats types. The economy of each city is analysed by sector, size, and demography, and the analysis estimates how much GDP output would be lost if each city were to experience different scenarios of shock for each threat.[1]

At present we analyse the loss of output as a measure of economic flow. We recognise that these catastrophes also cause loss to infrastructure, assets and the stock. Flow and stock are interrelated but this Index represents the risk to flow.

[1] Independent of the Global Risk Index, CCRS also model scenarios of events impacting multiple cities across a region and propagate the consequences to other unaffected cities that have economic co-dependence.

Expected loss

We do not predict that crises and shock events will occur. Each event is rare and unlikely. We analyse the small likelihood of each shock occurring and combine the chances of a rare catastrophe with its consequences to estimate the *expected loss* – the average probability-weighted amount of lost GDP, which produces the Cambridge Global Risk Index that can be used to compare different types of loss in various places and over alternative time horizons. The actual amount of lost economic production that would occur from a shock is many times larger than the probability-weighted expected loss index values that we present in this report.

We do not attempt to forecast which city will be hit by what type of events, but we assume that crises will continue to happen and that the risks of crises can be measured.

Threat selection and analysis

The analysis of each threat consists of threat assessments for each of the 300 cities, adoption of standardized metrics for frequency and severity of occurrence, localised impact severity scenarios, and economic impacts analyses. We gratefully acknowledge the expertise of our external subject matter specialists who have provided insights into each threat.

The 22 threats were identified as the most significant risks to the global economy through an extensive study of the shocks that have impacted society and the economy over the past thousand years, combined with reviews of published catastrophe typologies, emerging risk registers, and scientific conjectures of potential future threats. This was developed into the *Cambridge Taxonomy of Threats*, published in 2014. Some of these threats have been studied in detail, and published as stress test scenarios in the publication suite of the Cambridge Centre for Risk Studies, available from our website.

Economic baseline trend

The future growth of the global economy is an important part of the risk estimate. The expected projection of economic output provides a baseline trend that threats could potentially disrupt.

The analysis considers the economic output for the major cities of the world, with projections of future GDP each year for the next decade. This is based on the economic sectoral breakdown of the city's economy, its population demographics, and the dynamics of its national economy.

The economy of the world grew at an average rate of around 3% per year consistently from 1980 to around 2008, taking the world's annual output from $22.5 trillion to $63 trillion until the credit crisis. Global GDP fell to $59.8 trillion in 2009 in the Great Financial Crisis, and resumed growth from 2010 onwards, with annual growth rates of around 2.5% in the past few years.

Our advisors from Oxford Economics and other leading economists now expect that future GDP growth will not be as fast as suggested in forecasts from two years ago. They have downgraded their expectations for most of the world's leading economies, although projections for some countries' economies have improved. There is significant variation in the forecasts for different countries, with some emerging economies growing at rates between 4% and 7% a year, and many of the more developed economies seeing annual growth rates well below 2%.

Overall the latest projections suggest that by 2020 global GDP will have reached around $92 trillion. This is a significant reduction from the projections of two years ago, which estimated 2020 global GDP would reach $108 trillion. The latest projections suggest that GDP in 2020 will be only 85% of the level that was previously forecast. Overall, risk as the level of potential loss, is reduced with lower levels of economic output.

Recent developments in the threat environment

Major recent changes in the threat landscape are summarised below across five broad categories: *Finance, Economics and Trade Risks*; *Geopolitics and Security*; *Natural Catastrophe and Climate*; *Technology and Space*; and, *Health and Humanity*.

Finance, Economics and Trade Risks

Banking regulation is forcing major financial institutions to hold more risk capital and to de-leverage, making the financial system more stable and less likely for a crisis to spread and amplify through contagion processes. Basel III regulations have been under implementation since 2013 and most major institutions have now completed their compliance. This will not completely prevent future market crashes from occurring but it will mitigate the spread and severity of minor and moderate financial crises.

Recent economic shocks include the collapse in oil price in early 2015 and the subsequent slump in commodity prices in the months following. The Shanghai 'Black Monday' stock exchange crash of 24th August 2015 saw simultaneous corrections to many of the world's stock markets on a single day. Technology-related financial crises such as the flash crash accentuation of sterling devaluation following Brexit in June 2016, Bitcoin and block chain currency hack losses in April 2016, and the SWIFT 'Lazarus' attempted $1bn cyber heist in May 2016 indicate that algorithmic trading and technology innovation are growing vulnerabilities in the financial trading systems.

Financial crises are still likely to occur at the kind of frequencies that have been seen historically, and possibly more frequently because markets are becoming more interdependent and correlated, so that failures that originate in any part of the global financial system are quickly felt everywhere.

Asset bubbles, banking runs, and credit liquidity failures are the main historical triggers in past crises, and there are signs that each of these could potentially trigger new crises in the next few years. Italian and other European banks are among those on watch for potential difficulties. According to the IMF, global debt is growing, and reached a record $152 trillion in October 2016. The continuing low interest rate environment has fed the development of asset bubbles in real estate and debt markets. The potential for property price crashes in overinflated markets is a potential trigger for a future financial crisis.

Within the category of *Finance, Economics and Trade Risks* we identify the following general trends that relate our three-year outlook to the more stable ten-year baseline:

- Overall the expected loss from *Market Crash* threats is below its long-term average. The likelihood of a financial crisis being triggered by an asset bubble, banking run, or debt crisis remains elevated. Future financial crises will have reduced impact and spread due to the higher funding ratios held by financial institutions with Basel III compliance. Pressures for investment growth may see these protections eroded over time.
- *Sovereign Crisis* risk is elevated, with particular countries on heightened credit watch, mirroring rating agency assessments. The recent past has seen record numbers of sovereign downgrades by rating agencies.
- *Commodity Price* hikes from their current low levels are more likely, but these will be less impactful unless they reach levels well above their pre-2014 levels. This risk is below its long-term average.

Geopolitics and Security

We are in an era of increased geopolitical risk and uncertainty due to growing nationalism trends and a re-examination of the benefits from globalisation. This has resulted in democratic shocks, military tensions, social unrest, and a rise in anti-Western terrorism. These trends suggest that we may be entering a period of increased likelihood of conflicts and civil disorder.

The 'Long Peace' between major military powers that has prevailed since 1945 is unlikely to end anytime soon, but proxy wars and adventurism could make smaller scale conflicts more common, and increase the chances of escalating into a major conflict. Each of the potential interstate conflict scenarios in the analysis have very low probabilities, but are adjusted to reflect increased evidence of belligerence. The threshold of starting an interstate conflict may be eroded through cyber wars between nation-backed hacker units, escalating the common practice of interstate cyber espionage and vulnerability probing.

An increase in military tensions between major powers, with recent sabre-rattling between various antagonists in multiple theatres. The formal entry of Russia into the Syrian civil war has boosted Middle Eastern tensions, and created a potential flashpoint with Turkey. Russia's willingness to expand her influence has caused fears in Europe, questions over NATO commitments, and increased military spending by Western powers. In the Pacific

Rim, China's territorial disputes with Japan, Vietnam, Malaysia, and the Philippines have created instability. Recent military incidents highlight potential flashpoints between India and Pakistan; and the nuclear armament of North Korean threatens to destabilize the extended standoff with South Korea.

Terrorism is potentially entering a new phase with IS losing ground militarily to the anti-IS coalition in its self-proclaimed caliphate in Syrian and Iraq, and having its leadership eroded. It is beginning to disperse to other 'wilayets', including Libya, Yemen, and central Africa, and is transitioning to a virtual organization, raising the future spectre of cyber terrorism. The dispersal of IS could potentially lead to an increase in terrorist attack frequency in the West, such as those seen in France and Germany in 2016. The potential resolution of the leadership rivalry between IS and al-Qaeda could lead to reconciliation between the two groups and to a stronger allied attack force against the West.

While recorded incidences of social unrest such as protests, strikes, and riots have diminished worldwide since their peak in 2012-13, it continues to be a significant threat and may increase again in the near term. Separatism conflict has generally diminished – one example is the potential ending of the Colombia FARC war. Social unrest is potentially becoming more localised and issue-specific, such as civil rights protests in US, and reform-based political protest in China and other countries.

Within the category of *Geopolitics and Security* risks we identify the following general trends that relate our three-year outlook to the more stable ten-year baseline:

- *Interstate Conflict* risk is elevated, with growing military tensions in a number of geopolitical theatres, and potentially lower threshold for destructive conflict through cyber war.
- *Terrorism* risk is elevated, with IS dispersal and intent to attack the West.
- *Social Unrest* risk is similar to its long-term baseline, potentially slightly elevated, with reduced incidences of recorded strikes and riots.
- *Separatism Conflict* risk is on a par with or below its long-term baseline.

Natural Catastrophe and Climate

Natural catastrophes continue to cause destruction and localised economic disruption. Recent years have seen a lower than usual incidence of high-cost meteorological and geophysical disasters but notable events have included super-typhoons in the Pacific basin in 2014, earthquakes in Nepal (April, 2015) and Italy (August, 2016), air traffic disruption in the eruption of Mt Sinabung, Indonesia (June, 2015), and floods in UK and Northern Europe. Droughts continue in western US, southern Africa, and Brazil Cantareira.

The Cambridge Global Risk Index incorporates the geographical zoning of natural hazards and the return periods of them impacting the economies of each of the 300 cities.

There is a noticeable trend of increasing cost of natural catastrophes, due to the increasing exposure of more built property and higher value of infrastructure. There is also evidence that extreme climatic conditions are occurring more frequently as a result of climate change, although there is insufficient science to determine how future climate conditions will influence the frequency and severity of natural catastrophes, such as flooding, changing rainfall patterns and intensities, rising sea levels, and more extreme heatwaves, freezes and droughts, and possibly increasing severity of tropical windstorms. Most estimates suggest that these changes will take several decades to become significant, although it is possible that tipping points and non-linearity could produce surprises.

The most notable changes in occurrence of extreme weather come from climatic cycles such as El Niño Southern Oscillation (ENSO): phases of increased (El Niño) and decreased (La Niña) sea surface temperatures in the equatorial Pacific Ocean. El Niño phases are associated with warmer weather, heatwaves and droughts in the southern hemisphere and potentially more severe hurricanes in the Atlantic. La Niña phases are associated with cooler regimes in the southern hemisphere and increases in rainfall in the South Pacific and southern Asia.

El Niño and La Niña phases are irregular and strong phases last between 9 and 12 months and occur on average every two to 12 years. 2015 and 2016 saw an El Niño cycle and most predictions suggest that the next three years will be more likely to have periods of La Niña characteristics than El Niño, suggesting more risk of flooding in Latin America, Africa, India and Southeast Asia. However the predictive science is too uncertain to make a strong risk projection for the next three years above the long-term baseline.

Most Natural Catastrophe and Climate risks – *Earthquake*, *Tropical* and *Temperate Windstorm*, *Tsunami*, *Volcano*, *Freeze* and *Heatwave* – tend not to be time variable and so our three-year outlook aligns with the long-term baseline risk assessment. *Flood* risks may however elevate relative to the ten year baseline in certain regions depending on whether a strong La Niña phase emerges. Similarly, *Drought* risks may elevate if there is a strong El Niño phase.

Technology and Space

Technology threats are some of the fastest changing risks to the global and local economies.

Cyber attacks and disruption of the digital economy by malevolent actors is a growing problem that changes in technique and capability every month. The past year has seen a number of record-breaking cyber attacks, ranging from increasingly larger volumes of data stolen by hackers, to the unprecedented intensity of denial of service attacks, and scale of financial crime attempts.

Cyber attack on the Ukrainian power grid that caused power loss to 225,000 people in December 2015 and again the following year showed what economic and social damage future destructive cyber attacks might cause. IT specialists, law enforcement agencies, and national security organisations are now investing heavily to curb cyber threats. The non-jurisdictional nature of cyber hacking organisations will take some years of collective international effort to combat.

Our research in 2016 into the threat of solar storm has improved estimates of economic disruption. This has enabled us to upgrade our model of solar storm risk and to refine the geographical potential impact, which has reduced our risk estimates at lower latitudes. Significant efforts are underway by power grid operators in many countries at risk to reduce the vulnerability of their EHV transformer systems that should reduce this risk in the long-term. Large coronal mass ejections (CMEs) appear to be associated with the peak periods of the eleven year solar cycle, although a destructive CME could occur at any time. Cycle 24 of the sun activity phase peaked in 2013-14 and although the coming three years are in a declining phase of activity there is insufficient science to suggest that the likelihood of experiencing a solar storm will be reduced.

Power outage from accidental causes or weather remains a major risk of disruption in modern economies that rely on continuity of utilities and information technology. Technology threats of solar storm and cyber attacks similarly are ultimately most disruptive when they impact the grid and result in power outage. The power grid, spinning reserves, capacity, and system architecture ultimately control the geographical extent of potential outages and determine how rapidly power might be restored.

In many countries the increasing demand for power is exceeding the amount of new capacity being brought on line, resulting in power deficits that make extensive power outages more likely. Major blackouts have occurred recently in Turkey (March, 2015, 90% of the country); Pakistan (January, 2015, 80% of population); Kuwait (February, 2015, most of country) with other significant blackout events in Egypt, Bangladesh; South Africa; New Zealand; Malta; and the Philippines. Other countries, such as India, have invested heavily in building new generation capacity and improving grid infrastructure have reduced their chances of power outage.

Within the category of *Technology and Space* risks we identify the following general trends that relate our three-year outlook to the more stable ten-year baseline:

- *Cyber Attack* risk is increasing rapidly and is likely to remain highly elevated in the short term, with high uncertainty in the pattern of future risk. In the longer term international cooperation and law enforcement will reduce risk of economic disruption from cyber hackers.
- *Solar Storm* risk is on a long-term baseline decline as power grid operators reduce their vulnerability to geomagnetic damage. Cambridge modelling improvements have refined the geographical extent of risk of severe economic disruption from solar storm.
- *Power Outage* risk is trending to increase in countries with power deficits. In longer term, nations that invest in increased power capacity and improved resilience are expected to reduce their power outage risk.
- *Nuclear Accident* risk is relatively unchanged. Six nuclear power plants were decommissioned in 2015.

Health and Humanity

Recent disease outbreaks have illustrated the potential for epidemics to cause international economic disruption. The 2016 Zika virus outbreak has affected more than 20 countries in Latin America and Southeast Asia. The Ebola outbreak of 2014-15 has finally been contained. Other emerging infectious diseases with a medical cure continue to generate occasional cases, such as MERS, Avian Flu (H5N1), and new virus strains emerge such as influenza H7N9.

Pandemic risk in the future is decreasing: public health analysts have improved identification of potential epicentres of future pandemic outbreaks and primary health care surveillance has improved in these areas. Other factors such as improvements in vaccine capacity, stockpiles, and pandemic preparedness planning are also making gradual improvements in our ability to contain and mitigate pandemic outbreaks.

Some factors are increasing the potential for human epidemics. Major public health concern remains the potential emergence of drug resistant strains of endemic diseases, such as malaria and XDR tuberculosis, whose untreatable outbreaks would generate high economic shock impact, from diseases that are generally assumed conquered. There are also growing populations of closely farmed poultry and swine worldwide. Laboratory 'gain-of-function' experiments to improve our understanding of pathogen mutation have an added risk of accidental release of an artificially-cultured disease.

Plant Disease risk is stable because it is geographically constrained and slow spreading. Diseases pose a significant risk to some of the major staple crops that provide most of the nutrition to the global population. Risk is enhanced by modern agricultural practices that have reduced the biodiversity of cultivated strains.

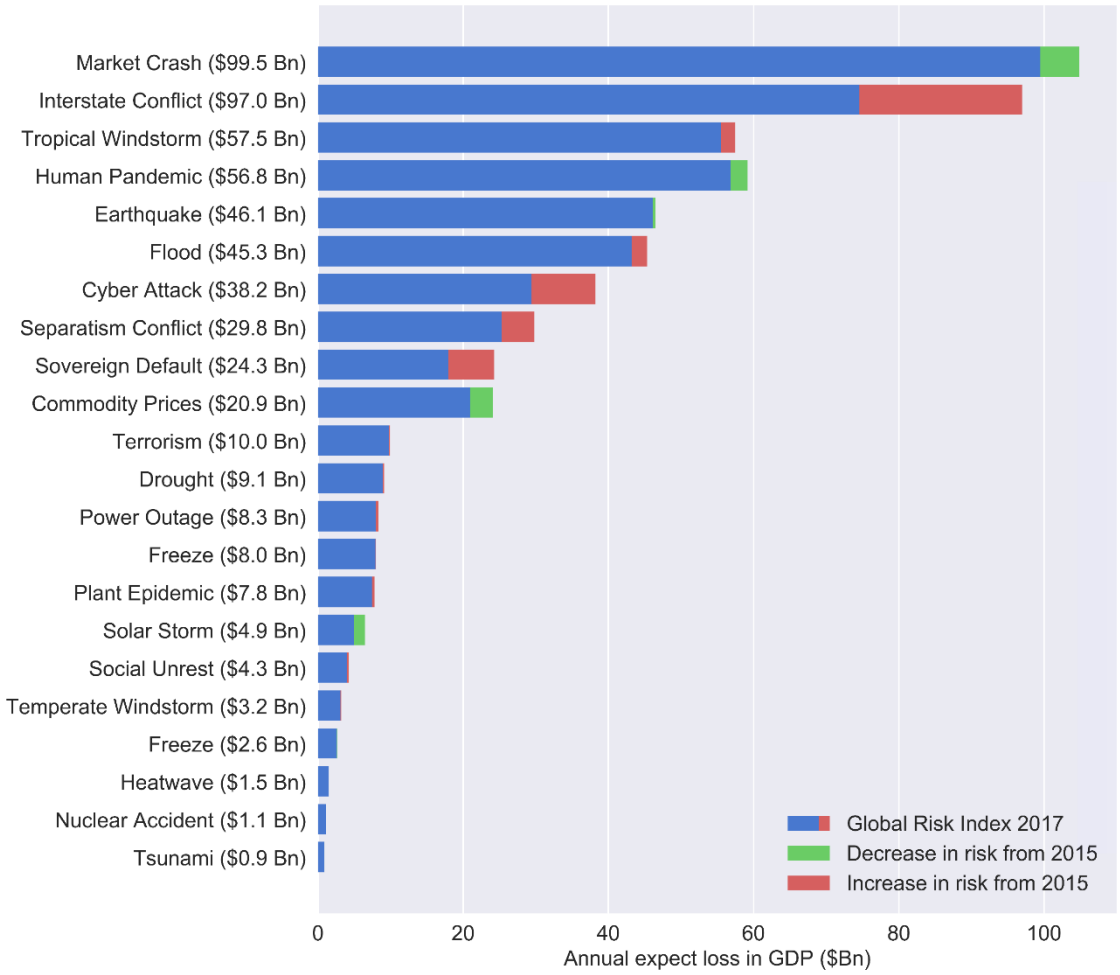

Figure 1: Global Risk Index 2017 by threat type

The new risk landscape

The recent changes in risk by threat are shown in Figure 1.

The remote but increased possibility of interstate conflict in theatres of the world, causes a significant addition of risk. The reduction in likely severity of future financial crises, as a result of improved banking liquidity, means that interstate conflict risk is now almost as severe a threat to the global economy as a market crash from another financial crisis.

Reductions in the risk of economic disruption from human pandemic, as a result of improved surveillance and medical preparedness, have downgraded this threat to below the ranking of wind storm, which has stayed as a constant threat in tropical regions. Risk of major economic shocks from cyber attacks is increasing, and is elevated by 20% above baseline as we face a period of increased risk. Commodity price risk sees a significant reduction as future hikes are expected, although these will be from a much lower baseline, therefore causing less economic shock loss when they occur.

Many of the other threats see significant changes, but not sufficient to change their ranking from our 2015 assessment.

Table 1: Top 30 cities most at risk from economic shocks, 2017

Short-term expected loss rank 2017	City name	Short-term annual expected loss ($US bn)	Short-term annual expected loss share of GDP	Change in rank from long-term baseline ranking	Change in expected loss from long-term baseline
1	**Taipei**	20.57	**5.0%**	-	2.0%
2	**Tokyo**	20.44	1.5%	-	11.7%
3	**Seoul**	13.76	**2.0%**	-	0.8%
4	**Manila**	13.10	**5.9%**	-	14.9%
5	**Istanbul**	12.06	**2.5%**	**1**	14.1%
6	**Tehran**	10.66	**5.5%**	-1	-1.7%
7	**Osaka**	10.02	1.8%	**1**	10.0%
8	**Mumbai**	9.72	**2.0%**	**5**	20.0%
9	**New York**	9.23	0.8%	-2	1.2%
10	**Delhi**	9.22	**2.0%**	**4**	19.7%
11	**Shanghai**	8.75	1.8%	-1	-0.7%
12	**Los Angeles**	8.73	1.0%	-3	-3.9%
13	**Lima**	8.65	**2.3%**	**2**	18.9%
14	**Hong Kong**	8.57	1.3%	-3	-2.3%
15	**Buenos Aires**	7.70	1.6%	-3	-10.0%
16	**Moscow**	7.25	1.1%	5	35.4%
17	**Sao Paulo**	7.09	1.1%	-1	11.9%
18	**Mexico City**	6.19	1.4%	**1**	14.6%
19	**Kuwait City**	5.89	1.6%	**8**	20.1%
20	**Khartoum**	5.86	**8.5%**	**12**	23.6%
21	**Baghdad**	5.72	**10.1%**	**14**	25.0%
22	**Karachi**	5.68	**4.6%**	**8**	16.4%
23	**Jakarta**	5.57	1.3%	**17**	34.5%
24	**Beijing**	5.47	1.3%	-6	-0.7%
25	**London**	5.46	0.9%	-5	1.2%
26	**Paris**	5.22	0.8%	-9	-7.2%
27	**Tianjin**	5.02	**2.0%**	-4	0.0%
28	**Tel Aviv**	4.94	**3.3%**	-3	-0.2%
29	**Guangzhou**	4.91	1.7%	-5	-1.0%
30	**Chengtu**	4.87	1.3%	-1	-0.4%

City risk rankings

The dynamics of change in risk for each city is the net result of risk adjustments to each threat type across the world. In aggregate, the risks are above baseline, growing in emerging markets and below baseline or reducing in many parts of the more developed economies. Certain regions of the world such as the Pacific Rim, the Middle East, the Indian subcontinent and Latin America have heightened risks.

The shifting landscape of risk affects the ranking of cities across the world by their total and individual risks. Table 1 shows the top 30 cities ranked by their short-term annual expected loss. Change in rank from long term to short term risk outlooks is also indicated.

The changes in risk for these cities are a result of the individual threat risk profile that prevail in each. Geopolitical risks are the primary drivers of change for most of the large changes in the higher ranking cities, with cyber, sovereign crisis, and other technology threats influencing the changes in several of the cities.

Emerging risk trends

Our analysis identifies three important emerging trends in the global risk landscape:

1. Emerging economies will shoulder an increasing proportion of risk-related economic loss because of both their accelerating economic growth and their increasing risk environment. Their risk environment is also less stable.
2. There is a growing prominence of man-made risks.
3. We see a heavy contribution from new or emerging risks, such as cyber attacks and infrastructure vulnerabilities.

Several evolving risks are supra-national – they transcend the ability of any individual country to deal with the risk or contain it on their own. It is only by international collaborative efforts that these systemic connected risks can be mitigated.

Managing risk in 2017

The risk landscape is changing. The Cambridge Global Risk Index provides an objective, evidence-based analysis of the risk of future economic shocks for use by business managers, policy makers, and financial risk decision-makers.

The Index provides guidance on where future disruptions to revenues and economic activity are most likely to occur. It provides a framework for incorporating the frequency and severity of future shocks into resilience planning, and inputs into risk registers and formal reporting of risks to shareholders and regulators.

The Index is structured to help with the cost benefit justification of improving city resilience. Policy makers can use the Index for civic continuity, economic security, and preparedness, particularly city administrations in identifying the key drivers of risk to the economic prosperity of their metropolis. Financial services companies providing risk capital can incorporate this type of analysis into their own techniques and country threat assessments.

Some risks included in the analysis are not incorporated in conventional risk management products and standard perils covered in traditional insurance. We think that a better understanding of these risks may provide opportunities for insurers to create new product offerings and address new markets, as the following sections of the report further explore.

Section 3: How Do City Risks Relate to Insurance Penetration Levels?

We outline our methodology in this section for estimating city non-life insurance penetration and its annual growth. The approach, summarised in Figure 2, draws on country insurance data and both country and city economic data. We then compare these city insurance penetration estimates to annual expected loss from catastrophes as estimated by the Cambridge Global Risk Index 2017 and summarised in the previous section. We conclude the section by making a further comparison relating expected loss with insurance penetration growth.

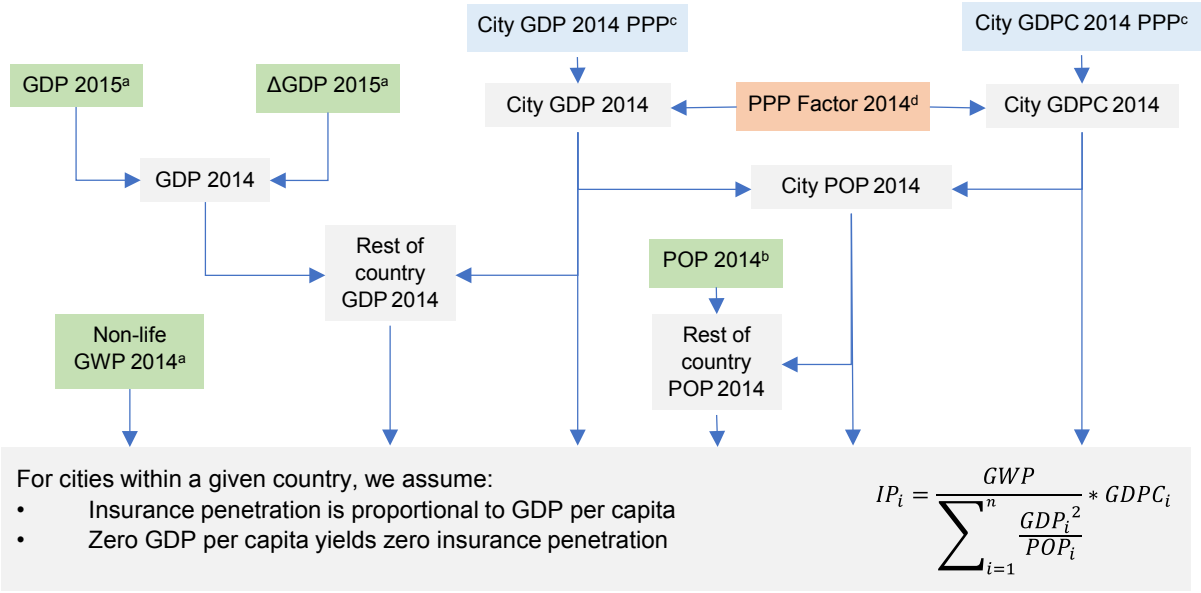

Figure 2: Summary of methodological process for estimating city insurance penetration[2]

Country insurance penetration

A country's insurance penetration measures the amount of insurance premium written in a year, its gross written premium (GWP), as a percentage of the country's gross domestic product (GDP). A country's GWP includes insurance for both domestic and foreign risk. It should be noted that the inclusion of cross-border business gives a much higher insurance penetration level for certain countries, such as Luxembourg, Italy and Ireland, which underwrite considerable foreign risk (Swiss Re, 2016).

A country with an increasing insurance penetration over time indicates a growing market for insurance relative to the overall growth of that economy. Comparing penetration levels across countries indicates how relatively developed each country's insurance industry is.

Our focus is on non-life insurance, which includes a wide range of products and lines, including property, casualty, motor and health, which have the potential for significant loss from catastrophe events, whether natural or man-made. Life insurance claims tend to be relatively independent of catastrophes due to policy exclusions.

We expect richer countries, with higher a GDP per capita that proxies the average standard of living in a country, to have higher insurance penetration levels: The more income an individual has or more profitable a company is, the more likely they are to seek insurance to protect the assets they own and mitigate liabilities to which they could be exposed. The relationship between non-life insurance penetration and GDP per capita is shown in Figure 3 across a selection of countries at different levels of development.

Inspection of Figure 3 shows that non-life insurance penetration appears to depend heavily on the GDP per capita of a country. However, penetration levels also depend on country-specific factors that account for the wide spread in the observed relationship. The Netherlands, for example, has mandatory private health insurance, which is a key driver behind a non-life insurance penetration level that is beyond the scale shown in Figure 3 at 10% of GDP in 2014 (*Insurance Europe*, 2014, p.24). Countries are also exposed to different types and levels of threats that can result in insurable losses. The threat landscape, regulatory environment and cultural norms are all likely to influence the insurance coverage of any given country.

[2] Nomenclature: GDP = gross domestic product, the economic output of a city; GDPC = gross domestic product per capita; PPP = purchasing power parity, an economic adjustment used to reflect localised price differentials; GWP = gross written premium, the total amount of insurance purchased in a region; POP = country or city population; and, IP = insurance penetration. Data sources: (a) Sigma: World insurance in 2015 (Swiss Re, 2016d); (b) Sigma: World insurance in 2014 (Swiss Re, 2015); (c) Global MetroMonitor 2014 (Parilla et al., 2015); and, (d) World Bank national accounts data and International Comparison Program database (The World Bank, 2017).

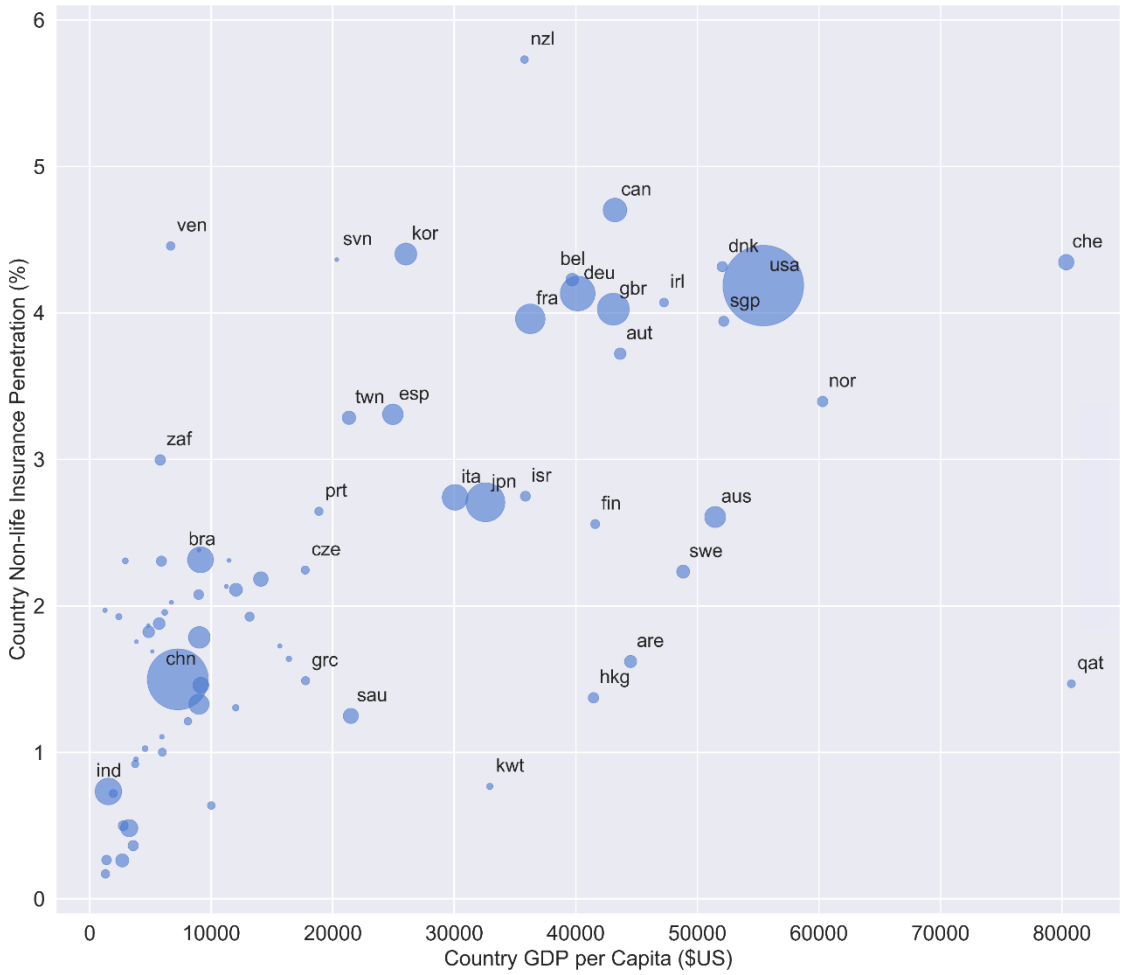

Figure 3: How insurance penetration levels depend on country wealth in 2014[3]

Swiss Re Economic Research & Consulting have previously identified that the relationship between non-life insurance penetration and GDP per capita takes the form of an 'S-curve' (Enz, 2000; Swiss Re, 2015):

- Countries with lower incomes have little awareness or ability to pay for insurance. Even significant increases in income have minor impact on the level of insurance penetration.
- However, for middle income countries the insurance penetration level tends to be highly sensitive to increases in income.
- And finally, countries with higher incomes seem to reach a saturation level of insurance because individuals can afford to take greater risks and affectively self-insure.

The selection of countries shown in Figure 3 are mostly middle to high income countries and hence the chart indicates the upper section of the familiar S-curve relationship.

[3] The Netherlands is not shown in the chart as it has a particularly high insurance penetration of 10% with a corresponding GDP per capita of $43,700. Data sources: Sigma World insurance in 2014 and 2015 reports (Swiss Re, 2016d, 2015). Estimates of insurance penetration and GDP per capita for 2014 are presented here to align with available city-level economic data from the Brookings Institute's Global Metro Monitor. Data from the "World insurance in 2015" report was primarily used: Country non-life GWP in USD in 2014 from Table VII (p.44); and, GDP in USD in 2015, GDP real change in 2015 and population in 2015 from Table X (p.47). GDP in USD in 2014 was estimated using 2015 GDP and adjusting for the real change in 2015. We considered this approach to be preferable to the use of 2014 GDP and GWP data reported in "World insurance in 2014" due to the use of provisional estimates in the earlier report. However, country population estimates for 2014 were taken from "World insurance in 2014". We then estimated GDP per capita in 2014 by dividing our 2014 GDP estimates with population in 2014 data. Country non-life insurance penetration was estimated by dividing 2014 non-life GWP by our 2014 GDP estimates and reported as a percentage of GDP.

Estimating city insurance penetration

In the absence of city-level insurance premium data, we follow a simple approach to scale country insurance penetration estimates, outlined above, to a city-level using additional city economic and demographic data. We rely on the most recent 2014 Global MetroMonitor performance indicators published by the Brookings Institution for this city data (Parilla et al., 2015). The Global MetroMonitor report compares the economies of the world's 300 largest metropolitan areas.[4] The key metrics reported are metropolitan area GDP, population, GDP per capita and annualised growth rate of real GDP per capita. The MetroMonitor indicators are themselves based on analysis of data from Oxford Economics, Moody's Analytics, and the U.S. Census Bureau.

To aid the comparison of different cities, MetroMonitor reports GDP and GDP per capita is US dollars adjusted for purchasing power parity (PPP). Since the country-level data is not adjusted in this way, we re-adjust back to US dollars using PPP factors estimated from The World Bank country data (The World Bank, 2017).

For the comparative analysis, we draw on expected loss data from the Cambridge Global Risk Index 2017 reported in percentage terms. Some cities represented in the Index form part of a, typically wider, metropolitan area defined in the Global MetroMonitor. For example, Seoul is represented in the Index, whereas the larger region of Seoul-Incheon is reported by the MetroMonitor. In such cases, we have manually matched metropolitan areas to our Index cities and assumed that threat environment, and hence expected loss in percentage terms, and insurance penetration levels for the city and the larger metropolitan area will be very similar.

A key assumption needs to be made in order to scale country non-life insurance penetration estimates to the city-level using the available data described above: Following the insight that at the country-level insurance penetration is highly dependent on GDP per capita, we assume that within a country insurance penetration is proportional to GDP per capita, that is, a city with twice the GDP per capita of another city in the same country will have an insurance penetration level that is also twice as high. An intercept is also required to fully define the country-specific relationship: We assume that a hypothetical GDP per capita of zero would yield zero insurance penetration. These assumptions yield Equation (1) that holds for any represented city i within a given country. The proportionality constant λ may take a different value for different countries.

$$IP_i = \lambda * GDPC_i \quad (1)$$

Where, IPi and GDPCi are the insurance penetration and GDP per capita of city i, respectively.

An important constraint must be honoured to define the proportionality constant: The sum of GWP across all n represented cities in a country and the rest of the country (ROC) region must equal the country's overall GWP, as expressed in Equation (2).

$$GWP = \sum_{i=1}^{n-1} GWP_i + GWP_{i=ROC} \quad (2)$$

The proportionality constant for a given country can now be defined by Equation (3).

$$\lambda = \frac{GWP}{\sum_{i=1}^{n} \frac{GDP_i{}^2}{POP_i}} \quad (3)$$

Where, GDPi and POPi are the GDP and population of city (or rest of country) i, respectively.

A given city's insurance penetration can then be estimated from the product of its parent country's proportionality constant and the city's GDP per capita, as per Equation (1).

[4] This is a different selection to the 300 cities assessed in our Index

To illustrate the approach, we can look at China and its major cities as an example. In 2014, China was estimated to have an overall insurance penetration of 1.5%, derived from $151 billion of GWP and a GDP of $10.1 trillion. This mapped to a GDP per capita of $7,250. Of the 37 Chinese cities represented in the Index, 32 could be matched to a metropolitan area reported in MetroMonitor (see Table 2 for a listing). Using GDP and population estimates for these cities from MetroMonitor and our own estimates for the rest of country (based on equality constraints similar to Equation (2)), a proportionality constant of 1.67e-6 was derived from Equation (3). Insurance penetration levels for each city were then estimated using Equation 1 with MetroMonitor GDP per capita values, which are presented in Table 2. GDP per capita ranges widely from $5,555 in Nanning to $29,739 in Suzhou, giving insurance penetration levels between 0.9% and 5%. Of the 32 Chinese cities listed in Table 2, our estimates indicate that 24 cities have an insurance penetration level that is higher than that of China's overall level of 1.5%.

Table 2: Estimated insurance penetration levels for 32 Chinese cities

City name	GDP per capita in 2014	Estimated insurance penetration in 2014	City name	GDP per capita in 2014	Estimated insurance penetration in 2014
Suzhou	29,739	5.0%	**Hefei**	12,335	2.1%
Wuxi	25,589	4.3%	**Tangshan**	11,934	2.0%
Shenzhen	19,284	3.2%	**Xiamen**	11,702	2.0%
Dalian	19,191	3.2%	**Jinan**	11,141	1.9%
Nanjing	17,971	3.0%	**Nanchang**	10,585	1.8%
Changzhou	17,268	2.9%	**Dongguan**	9,524	1.6%
Guangzhou	16,587	2.8%	**Chengdu**	9,389	1.6%
Shenyang	14,875	2.5%	**Changchun**	9,383	1.6%
Changsha	14,374	2.4%	**Zhenzhou**	8,522	1.4%
Hangzhou	14,085	2.4%	**Taiyuan**	8,347	1.4%
Tianjin	13,849	2.3%	**Xian**	8,274	1.4%
Shanghai	13,758	2.3%	**Kunming**	7,671	1.3%
Beijing	13,372	2.2%	**Xuzhou**	7,493	1.3%
Qingdao	13,310	2.2%	**Harbin**	7,355	1.2%
Ningbo	13,236	2.2%	**Chongqing**	6,012	1.0%
Wuhan	12,991	2.2%	**Nanning**	5,555	0.9%

Our estimates of city-level insurance penetration provide an indicator of the relative extent of each city's insurance market. As already noted, each city has a unique risk profile across a range of threats that could result in insured losses. To better understand the role risk plays in driving insurance markets we can compare city insurance penetration and expected loss estimates.

Comparing city insurance penetration with expected loss

A comparative analysis can now be made between our estimated city non-life insurance penetration levels and annual expected loss from catastrophes as estimated in the Cambridge Global Risk Index 2017.

The top left-hand side chart of Figure 4 (page 16) shows the relationship between city insurance penetration and overall expect loss as a percentage of GDP across all 22 threats assessed in the Index.[5] The general trend is one of high insurance penetration for relatively low expected loss (less than 1%), corresponding to more advanced city economies, and low insurance penetration for relatively high expected loss (greater than 1%), corresponding to emerging city economies. However, there are exceptions to this general trend, for example: Taipei has both a very high expected loss (5.0%) and a relatively well developed non-life insurance penetration level (4.0%); Caracas as an emerging economy has a particularly high penetration level (8.7%) for a reasonably high expected loss (1.9%);

[5] The 177 cities included in the analysis and shown in Figure 4 are all the cities that are represented in both the Cambridge Global Risk Index 2017 and the 2014 Global Metro Monitor and that have their parent country represented in Sigma insurance reports.

Singapore, as a more advanced economy, has a relatively low penetration level (0.7%) given a low expected loss (0.9%); and, Seoul appears to have a more developed insurance market than the general trend would suggest.

The 22 threats assessed in the Index are grouped into five high-level categories: *Natural Catastrophe and Climate; Finance, Economics and Trade Risks; Geopolitics and Security; Technology and Space*; and, *Health and Humanity.* We have isolated the expected loss from threats falling within each of these categories and compared this with city insurance penetration in the remaining five charts of Figure 4, with the result that the general relationship is quite different across these disaggregate threat categories:

- With *Natural Catastrophe and Climate* threats – including *Earthquake, Tropical* and *Temperate Windstorm, Tsunami, Flood, Volcanic Eruption, Drought, Freeze*, and *Heatwave* – accounting for a major share of overall expected loss for high loss cities, the insurance penetration trend for this threat category is like that already described for overall expected loss.
- No strong general trend can be discerned for *Finance, Economics and Trade Risks* – including *Market Crash, Sovereign Crisis*, and *Commodity Prices*. Insurance penetration varies widely across the range of expected loss. Expected loss also does not appear to correlate with city development status in terms of advanced or emerging city economies.
- For *Geopolitics and Security* threats – including *Interstate Conflict, Terrorism, Separatism Conflict,* and *Social Unrest* – there again appears to be a strong inverse relationship much like the overall trend. However, Seoul, Israel, and Morocco have relatively high penetration levels (4.8%, 3.3%, and 3.1%, respectively) given high expected loss from geopolitical threats (0.5%, 1.9%, and 2.3%, respectively).
- The relationship is reversed for *Technology and Space* threats – including *Nuclear Accident, Power Outage, Cyber Attack*, and *Solar Storm* – with more advanced city economies at relatively high penetration levels being associated with higher expected loss.
- A strong separation between advanced and emerging city economies is found in the expected loss from *Health and Humanity* threats – including *Human Pandemic* and *Plant Epidemic* – with emerging cities, particularly those in China for example, having high expected loss. Since China's cities have insurance penetration levels ranging from 0.9% to 5% the general inverse relationship between penetration and expected loss is less distinct for this category.

Insurance penetration growth

While emerging city economies typically have relatively low insurance penetration levels compared to more advanced cities, many have high growth rates. This is particularly so for Chinese cities where the country's average annual growth in insurance penetration is nearly 10%.

It seems reasonable to assume that if non-life insurance penetration has a strong relationship with GDP per capita, then growth in insurance penetration would also have a strong relationship with growth in GDP per capita. This relationship is illustrated in Figure 5 (page 17) for growth in 2014. We do not think that a strong relationship can be discerned as we might have expected. This may be due to lag effects for example that see growth in insurance purchasing only after gains in income have been recorded, or simply that country-specific factors take precedence in this case (for example regulatory change driving mandatory insurance purchasing behaviour).

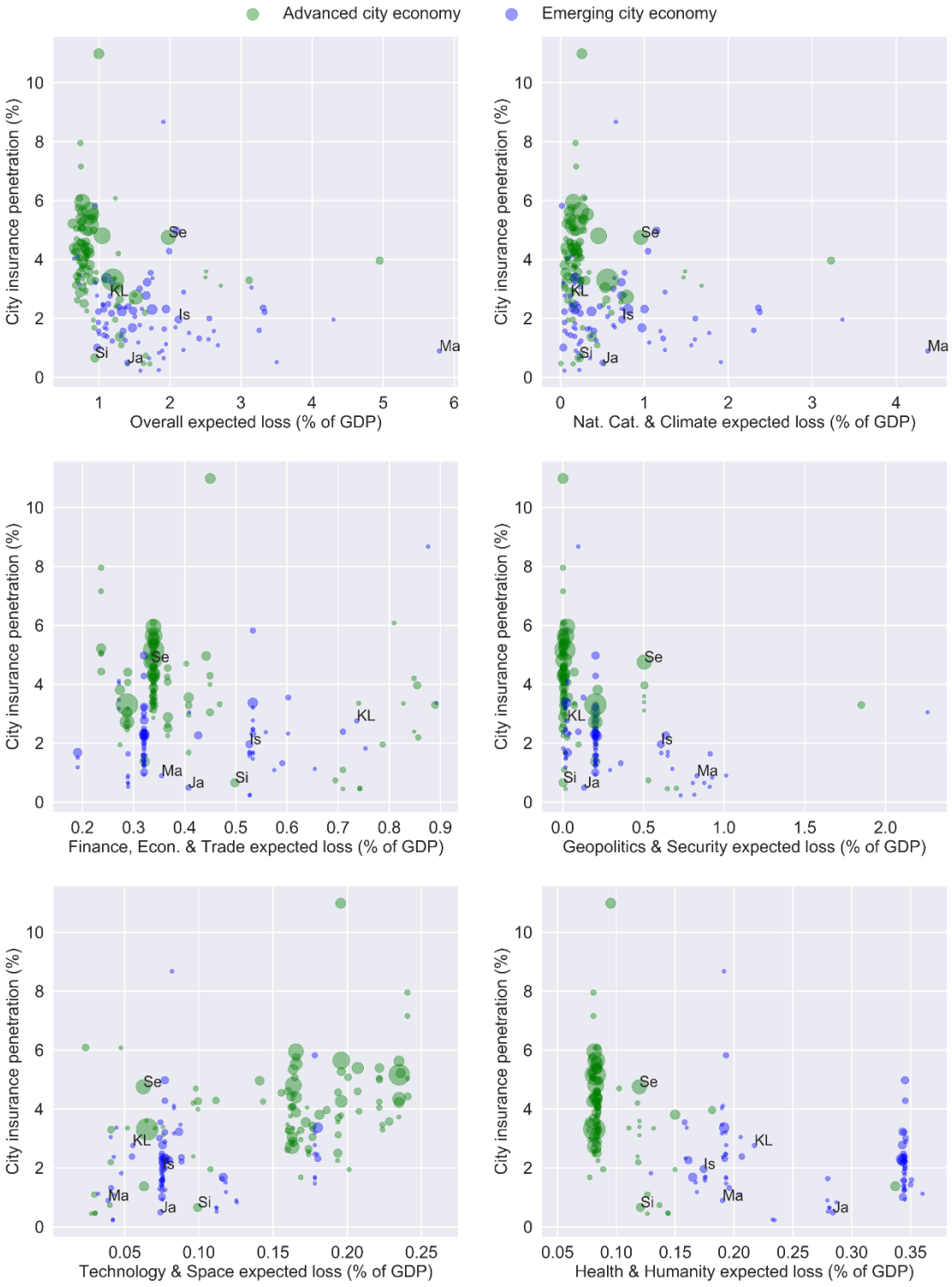

Figure 4: Comparison of city insurance penetration with expected loss share of GDP from all threats combined and individual threat categories[6]

[6] Cities are identified as having either *advanced* or *emerging* economies, which correspond to *developed* and *developing* statuses, respectively, reported in the Global MetroMonitor data (Parilla et al., 2015). Six cities are also identified for comparative purposes and referenced in Section 4 of this report: Seoul (Se); Kuala Lumpur (KL); Istanbul (Is); Manila (Ma); Singapore (Si); and, Jakarta (Ja).

Figure 5: How insurance penetration growth in 2014 relates to country GDP per capita change in the same period[7]

We therefore allocated overall country insurance penetration growth to all represented cities in each country, independently of city-level variation in GDP per capita growth as reported by the Brookings Institution's Global MetroMonitor performance indicators for 2014 (Parilla et al., 2015).

Comparing city insurance penetration growth with expected loss

Although we estimate all cities within a given country to have the same insurance penetration growth as the overall country, it remains insightful to observe the relationship between this growth and individual city expected loss share of GDP from the Index, which is shown in Figure 6 (page 18).

[7] Lebanon and Ukraine with GDP per capita change of -16.1% and -11.5%, respectively, are not included in the chart. Data sources: Sigma World insurance in 2014 and 2015 reports (Swiss Re, 2016d, 2015). Additional data from the "World insurance in 2015" report included country non-life GWP inflation adjusted percentage change (in local currency) in 2014 and 2015 (p.43). We took the average percentage change across these two years to dampen some of the reporting volatility of this growth metric and reassigned this value as the 2014 percentage change in GWP. If premium growth was only reported in one period then this value was taken rather than an average. Percentage change in country GDP per capita was estimated based on GDP and population data derived from both Sigma reports as in the earlier analysis.

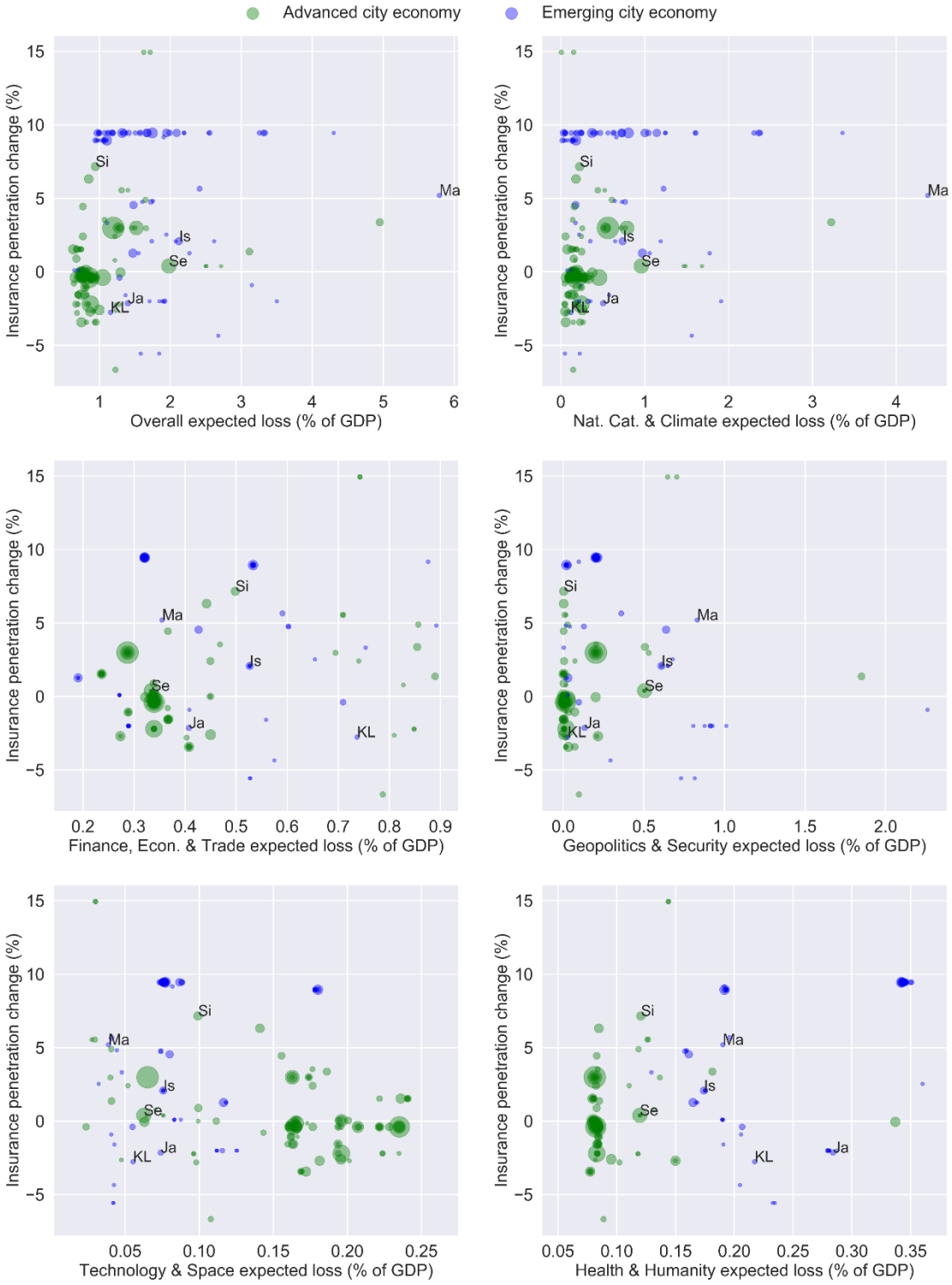

Figure 6: Comparison of city insurance penetration growth with expected loss share of GDP from all threats combined and individual threat categories[8]

[8] Again, cities are identified as having either *advanced* or *emerging* economies, which correspond to *developed* and *developing* statuses, respectively, reported in the Global MetroMonitor data (Parilla et al., 2015). Six cities are also identified for comparative purposes and referenced in Section 4 of this report: Seoul (Se); Kuala Lumpur (KL); Istanbul (Is); Manila (Ma); Singapore (Si); and, Jakarta (Ja).

The top left-hand side chart of Figure 6 shows the relationship between city insurance penetration growth and overall expect loss as a percentage of GDP across all 22 threats assessed in the Index. The general trend is not strong but there appears to be a slight tendency for cities with higher expected loss to have more robust growth in insurance penetration. However, Calcutta, Morocco, and Almaty are examples of cities with high overall expected loss (3.5%, 3.2% and 2.7%, respectively) but with a negative change in insurance penetration (-2.0%, -0.9% and -4.4%, respectively).

The expected loss from threats falling within each of the five high-level categories is compared with city insurance penetration growth in the remaining charts of Figure 6. Although the relationship is again quite different across these disaggregate threat categories, overall trends are difficult to discern. Observations on a city-by-city basis are more revealing and specific examples are discussed in the following section in the context of identifying market opportunities for insurers.

Section 4: **Risk-Driven Insurance Opportunities**

In this section, we embed the analytical findings from Section 2 and 3 within the context of risk-driven insurance opportunities, particularly for emerging markets. Six example cities, facing diverse threats and levels of insurance penetration, are used to help focus the discussion.

We begin by outlining a provisional mapping of how each of our five threat categories are likely to impact different insurance lines and exposure types. We then provide a high-level view of insurance market growth, including the identification of key drivers and inhibitors to uptake, before highlighting how insurance opportunities may be realised by aligning product offerings with the specific risks facing individual cities.

Mapping threats to insurance lines and types of exposure

The Cambridge Global Risk Index estimates expected loss in city GDP from different threats. The methodological approach does not currently estimate direct damages, for example to physical assets and infrastructure. Therefore, it is hard to infer which insurance lines are likely to be affected by threat-specific impacts on distinct types of exposure. However, a provisional mapping of threat categories to insurance lines and types of exposure is presented in Table 3, in terms of likely insurance loss being either *High, Medium* or *Low*.

Table 3: Indicative insurance line loss from threat category impacts on exposure types

Insurance lines	Exposure type	Finance, economics & trade	Geopolitics & security	Natural catastrophe & climate	Technology & space	Health & humanity
Commercial property	Physical damage	-	Low	High	Medium	-
	Revenue loss / BI	-	Low	High	Medium	Medium
	Contingent BI	-	Low	Medium	High	-
Commercial political risk / war market	Physical damage	-	High	-	-	-
	Revenue loss / BI	-	High	-	-	-
	Human injury, illness or death	-	Medium	-	-	-
	Financial asset devaluation	Low	Medium	-	-	-
Casualty liability	Duty of care to 3rd party	Medium	Medium	Medium	Medium	Medium
	Human injury, illness or death	-	Medium	Medium	Low	Medium
Liability D&O; E&O	Financial asset devaluation	Medium	Low	Low	Medium	Medium
Workers comp	Human injury, illness or death	-	High	Medium	Low	Medium
Credit & surety	Financial asset devaluation	High	Medium	Low	Low	Medium
Personal accident	Human injury, illness or death	-	Medium	Medium	Low	Medium
Cyber liability	Digital asset loss	-	Low	-	High	-
Life & health	Human injury, illness or death	-	Low	Low	Medium	High
Pensions & annuities	Financial asset devaluation	High	Low	Low	Medium	Low

Commercial property insurance is most at risk from *Natural Catastrophe and Climate* threats causing physical damage and business interruption and *Technology and Space* threats causing contingent business interruption (for example due to loss of electricity supply following a solar storm induced grid failure). Although *Geopolitics and Security* threats may cause considerable business interruption and damage to commercial property, policy exclusions are likely to minimise insurance losses in this line. However, commercial political risk and war market products designed specifically to cover such threats will see significant loss due to physical damage, business interruption, human injury, and financial asset devaluation.

All threats have the potential to drive third party liability losses, while human injury caused by *Geopolitics and Security, Natural Catastrophe and Climate* and *Health and Humanity* threats is likely to cause casualty, workers compensation, and personal accident claims. Director and officer liability, error and omissions liability and credit and surety products covering financial asset devaluation may also see losses from all threats, particularly *Finance, Economics and Trade Risk* threats.

Cyber liability insurance covering digital asset loss will primarily be impacted by *Technology and Space* threats, which includes the threat of cyber attack. Life and health insurance products will see particularly heavy losses from human pandemics. Finally, financial asset devaluations from *Finance, Economics and Trade Risk* threats are likely to realise significant losses from pensions and annuities insurance.

It is reasonable to think that for underinsured regions the extent of potential loss from a given line of insurance would be well correlated to the growth in premium in that line. However, as the next section illustrates, there is a complex set of drivers and inhibitors of insurance market growth, particularly in emerging markets.

Non-life insurance market growth in emerging markets

Growth in the overall non-life insurance market continues to be strongest in emerging economies. With the help of recently stabilised commodity prices and improvement in general economic conditions, real annual premium growth in emerging markets is expected to increase from about 5% in 2016 to nearly 7% by 2018 (Swiss Re, 2016b). This compares to around 2% annual growth in advanced markets. However, several important emerging economies currently go against the general trend. For example, high inflation in Brazil more than offsets the non-inflation-adjusted growth in premium (OECD, 2017).

Alongside general improvements in economic conditions, increasing new vehicle sales and home ownership are among the key drivers of premium growth in many emerging markets. For example, property and casualty premium growth in emerging Asia is driven by motor insurance which represents a majority share of premium (McKinsey & Company, 2015). However, non-motor insurance products are likely to become more important as China lifts regulated tariffs in this line in favour of allowing prices to be set by market competition.

Growth in liability products is expected due to increasing attention on business reputation, environmental protection, and food and product safety (Swiss Re, 2016b). Regulatory initiatives – for example, the New Crop Insurance Scheme in India – and growing recognition of property underinsurance in high risk regions is also likely to drive demand for natural catastrophe products (Lloyd's, 2012; EY, 2016).

Large-scale infrastructure projects are also seen as major drivers of future non-life premium growth in emerging markets. For example, China's Belt and Road Initiative, aimed at improving the connections China has with its neighbours and the broader region, is expected to trigger a wave of construction activity along with an agenda of trade liberalisation. As a result, demand for property, marine and engineering lines of insurance is expected to significantly increase (Swiss Re, 2016a). China is also playing a leading role in driving infrastructure development in Africa, that could lead to future growth in motor and property premium in the region (Swiss Re, 2016c).

Key drivers of growth

There are many complex factors influencing insurance growth in emerging markets and they vary considerably from one region to the next. In general, however, we have identified the following factors to be of key importance:

- The state and rate of economic development is perhaps of paramount importance: There is typically a greater demand for insurance premium as an economy grows in terms of GDP.
- The growth of middle-tier corporations in emerging markets, fuelled by access to international finance and outsourcing patronage.

- Increased demand and awareness following major catastrophe events with large ground-up losses, particularly those that are highly publicised.
- Trading relationships with more advanced economies can drive insurance uptake, for example through investor accountability to international standards and knowledge spillovers.
- Regulatory change in the form of new laws and guidelines – dealing with issues such as anti-corruption, investigation and prosecution, health and safety, and environmental protection – can have a major impact on the demand for specific lines of insurance, particularly liability.
- Enhanced risk perception of senior management, itself driven in part by the educational function of retail insurance brokers.
- Technological innovations – for example mobile communications or index-based agriculture insurance – can enable risk transfer or mitigation and increase awareness and demand for certain insurance products.

Key inhibitors of growth

Conversely, there are also many factors limiting the growth of the non-life insurance market in emerging markets:

- Again, the state of a region's economy is crucially important. Economic recession, low commodity prices or high inflation can severely impact demand for non-life insurance.
- Current insurance market size is a critical factor because global insurers are often inhibited from investing in the servicing of markets with currently low premium volumes. Similarly, insurer investment is likely to be curtailed for particularly marginal lines of business.
- Potential purchasers of insurance may see insurance as prohibitively expensive.
- The complexity of traditional product structures may be a factor in some cases. Product segmentation by different exposures and coverages along with multifaceted terms and conditions make it challenging for potential new consumers to evaluate costs and benefits of insurance.
- Monetary policies delivering low interest rate environments may be encouraging companies to self-insure against risk through the availability of cheap borrowing.

Risk-driven alignment of insurance products

We think it is striking to note that the actual extent and nature of the risks facing a region may not currently be among the most important factors influencing the growth of insurance against those risks. However, we believe that a rationalised product offering that is aligned to the specific risks facing a region or city could present significant market opportunity for an insurer.

We have selected six cities – Seoul, Kuala Lumpur, Istanbul, Manila, Singapore and Jakarta – to further explore this idea. The overall expected loss and individual threat category expected losses for the six select cities are shown in Figure 7 (page 22). The cities face potential losses from quite diverse threats. For example, Kuala Lumpur faces relatively high losses from *Finance, Economics and Trade Risk* and *Health and Humanity* threats and is relatively less exposed to *Natural Catastrophe and Climate* and *Geopolitics and Security* threats, while the opposite holds for Seoul.

The six cities also exhibit a range of non-life insurance penetration levels, which for 2014 are shown as a percentage value next to each city name in Figure 7. Seoul has the highest penetration level at 4.8% and Jakarta has the lowest at just 0.5%. If the extent of risk facing a city were the primary factor driving insurance uptake, then we would expect Manila to have the highest penetration level, however it is well behind Seoul, Kuala Lumpur and Istanbul at 0.9%.

The relative risk from each threat category is more subjectively defined for the six cities in Table 4, in terms of being either *High*, *Medium*, or *Low*. In addition, by combining these assessments with the indicative insurance line loss estimates from Table 3, the extent of alignment between each insurance line and the overall risk facing each city is estimated in the lower section of Table 4 (page 23) as being either *Strong*, *Moderate*, or *Weak*.

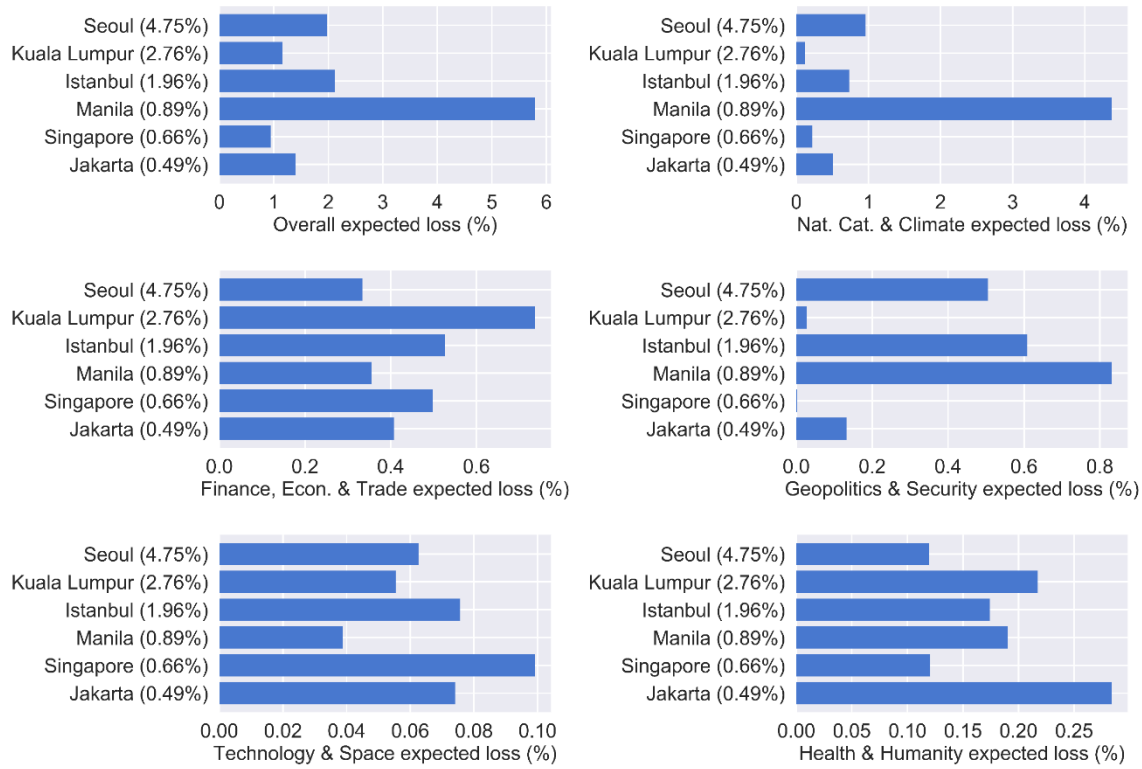

Figure 7: Comparison of select city insurance penetration with expected loss share of GDP from all threats combined and individual threat categories[9]

There are clear differences in the mix of insurance products that have growth potential in different emerging markets. Of the six cities, Istanbul appears to align strongly across most lines of business. With a moderate non-life insurance penetration level of 2% in 2014, a 2% increase in the penetration level during 2014, and an annual non-life premium growth that is expected to be more than 5% by 2018 (Swiss Re, 2016b), Istanbul presents a promising overall insurance opportunity.

Singapore is the most polarised of the six cities. The city is well aligned with several liability lines including directors and officers, errors and omissions, and cyber along with credit, surety, pensions and annuities lines that also cover financial asset devaluations. This is due to considerable risk from *Technology and Space* threats and a medium risk from *Finance, Economics and Trade Risk* threats. Conversely, low risk from *Geopolitics and Security, Natural Catastrophe and Climate* and *Health and Humanity* threats – that all tend to be associated with physical damages and human injury – means that the city is relatively poorly aligned with commercial property, political risk, casualty liability, workers compensation, and personal accident lines of business. Starting from a very low penetration level in 2014 of 0.7% but with very high annual growth of 7.2% in the same year, Singapore appears to present significant opportunity for specific non-casualty liability lines and products providing cover for financial and digital assets.

Manila is somewhat polarised in the opposite way to Singapore. Again with a low penetration level in 2014 of 0.9% but with high risk from *Geopolitics and Security* and *Natural Catastrophe and Climate* threats means that the insurance opportunity for Manila lies with casualty liability products and lines covering physical damage and business interruption, such as commercial property and political risk.

We believe this simple mapping framework provides a powerful example of how analytical tools can be used to indicate the types of insurance products that are likely to best meet the different needs of risk management by the businesses in different cities. This type of analysis can help insurers develop targeted and rationalised product offerings to better realise the insurance opportunities in emerging markets.

[9] Data points correspond to those also shown in Figure 4. Each city's insurance penetration level is indicated next to its name as a percentage value.

Table 4: Indicative risk-driven alignment of insurance products for select cities

		Seoul	Kuala Lumpur	Istanbul	Manila	Singapore	Jakarta
Insurance penetration 2014		4.8%	2.8%	2.0%	0.9%	0.7%	0.5%
Change in insurance penetration 2014		0.4%	-2.8%	2.0%	-2.8%	7.2%	-2.2%
Risk by threat category	Finance, economics & trade	Low	High	Medium	Low	Medium	Low
	Geopolitics & security	High	Low	High	High	Low	Medium
	Natural catastrophe & climate	Medium	Low	Medium	High	Low	Medium
	Technology & space	Medium	Medium	Medium	Low	High	Medium
	Health & humanity	Low	Medium	Medium	Medium	Low	High
Alignment of insurance line with city risk	Commercial property	Moderate	Weak	Strong	Strong	Weak	Moderate
	Commercial political risk / war market	Strong	Weak	Strong	Strong	Weak	Moderate
	Casualty liability	Strong	Moderate	Strong	Moderate	Weak	Strong
	Liability D&O; E&O	Moderate	Strong	Moderate	Weak	Strong	Moderate
	Workers comp	Strong	Weak	Strong	Strong	Weak	Moderate
	Credit & surety	Moderate	Strong	Strong	Moderate	Strong	Moderate
	Personal accident	Moderate	Weak	Moderate	Moderate	Weak	Moderate
	Cyber liability	Strong	Moderate	Strong	Moderate	Strong	Weak
	Life & health	Weak	Strong	Strong	Moderate	Moderate	Strong
	Pensions & annuities	Moderate	Strong	Moderate	Weak	Strong	Weak

Section 5: **Conclusions**

The Cambridge Global Risk Index 2017 provides a map of the risk landscape ahead. Understanding the patterns of future risk is the key to successful risk management. We provide these analytics to help businesses, policy-makers, financial services providers, insurers, and other professional risk managers gauge their planning decisions, strategies and investments. We estimate that over half of this risk can be mitigated by improvements in resilience and investment in risk management.

Increasing insurance coverage, particularly in emerging markets, provides a key element to an overall risk mitigation strategy, whether for a business or a city. However, insurance growth dynamics and insurance purchasing decisions are driven by multiple variables. This is reflected by the fact that insurance penetration does not correlate positively with the extent of risk facing a region or city, indeed the opposite appears to currently hold.

Risk perception, including knowledge of past catastrophe events and insights gained from objective metrics, such as expected loss reported in our Index, plays a key role in driving growth. Progressive regulatory regimes, shareholder accountability, and exposure to international standards can also spur growth.

Furthermore, we believe that matching insurance products to the risk profile of local markets is critical for increasing insurance uptake. To that end, we have developed a prototype analytical framework that first maps different threats to impacts on exposure types and, ultimately, likely losses across different insurance lines, and that then uses this map to link a city's risk profile to likely insurance line growth opportunities.

Finally, although the analytical approaches discussed in this report centre on the city as an economic unit, we think that there are significant opportunities to extend and refine these techniques to produce insurance purchasing frameworks for individual companies.

Section 6: **References**

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