Conceptualizing City Fragility and Resilience

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Executive Summary

For the first time in history, more people live in urban settlements than outside of them. The concentration of people, power, and wealth in cities creates many possibilities for tackling some of the world's most pressing problems.[2] At the same time, urban areas are on the frontline of challenges that range from climate change and extreme poverty to multiple layers of violence and pandemics.[3]

Despite the actual and future challenges facing cities, there is no systematic way to assess which ones are most at risk of failing to fulfill their core functions when challenges materialize. Nor are there ways to determine which cities are better positioned to sustain their core functions in the wake of shocks and stresses. This is particularly true for the thousands of cities in low- and medium-income countries, of which we know virtually nothing. In shorthand, what is needed are frameworks to help public policy makers and practitioners have a better sense of the dynamic risks and protective factors that shape the extent of city fragility and resilience beyond the one-hundred or so global cities that are the focus of most city based assessments.

This paper introduces a preliminary analytical framework that re-conceptualizes fragility and resilience at the city level. It aligns the two concepts across a range of political, social, economic and environmental factors enabling comparison across thousands of cities globally based on existing data. The framework was then partially applied to map out fragility in over 2,100 cities. It finds that roughly 14 percent of the sample score in the highly fragile range. Another 66 percent report average levels of fragility while 16 percent report low fragility.[4] Of course, fragility and resilience are both dynamic and change over time. The paper finds that all cities are fragile to some degree, though intensity varies in relation to the aggregation of risk.

The framework proposed here is still in the process of being developed. It has been reviewed by a wide range of specialists in the social and natural sciences. The framework is intended to complement existing approaches, which often require resource intensive self-assessments and the capacity to collect detailed data that is out of reach for most cities across the world. The expectation is that this framework can help public authorities, private entities, civil society groups and others to better apprehend and anticipate key risks shaping urban fragility globally. Another goal is to help trigger reflections on appropriate protective factors that can strengthen and bolster resilience, albeit while being mindful of the complex interplay between the two. No single framework will adequately explain the complex ecosystem of cities. But informed reflection may push theory building forward so as to help administrators better prepare for the urban age.

Introduction

Cities are on the frontline of key global challenges shaping the 21st century. From climate change to migration, inequality to pandemics, and criminal violence to war and terrorism, cities are the principal theatres where these problems play out and are addressed.[5] Given demographic trends, cities are likely to come under increasing pressure and only very few of them are adequately equipped with the tools to deal with the threats they will almost certainly encounter.

There are a myriad of risks facing cities that induce fragility and thus limit their capacity to fulfill their core functions, which include ensuring the security and safety of people, property, and infrastructure; delivering basic services such as public health, water, sanitation and electricity; and guaranteeing basic norms and rights. Most of these risks combine both exogenous and endogenous characteristics. Internal risks can include being situated in a flood plain or having extremely poor, to non-existent, infrastructure. External risks could include cyclones and armed conflict in neighboring areas that can spill over in the form of unregulated migration and associated political and social backlash.

City fragility is seldom a result of a monolithic root cause. Rather, the evidence suggests that it is the cumulative effects of overlapping political, social, economic, and environmental risks that drive fragility.[6] The extent and character of fragility varies across continents, regions, countries and cities. While some cities in the Americas, Africa, and Asia are thriving, others on these same continents are falling behind. In some cases, even in some comparatively developed cities across North America and Western Europe, the social contract binding urban authorities and citizens has started unraveling.

Meanwhile, there is growing attention being paid to the potential of city resilience as a means of preventing, recovering from, and adapting to human and naturally-induced threats while maintaining core functions.[7] A diverse array of frameworks has emerged with the intention of measuring fragility and resilience, including at the city-level.[8] However, few of them have been empirically derived beyond a limited number of case studies. Indeed, the existing literature on urban resilience is notable for its comparatively weak evidence base.[9]

This paper proposes a conceptual framework to assess the extent of fragility and resilience in cities around the world. It builds on previous studies to ground the two concepts,[10] and sets out correlates to understand city fragility and resilience around the world. The framework suggests that city fragility can be measured empirically by inspecting the key risks that when realized can lead to the inability of a city to fulfill its core functions. Likewise, resilience can be assessed through the identification of key factors enabling a city to maintain its core functions in the wake of shocks and stresses.

The framework is intended to complement existing indices and approaches, which often require resource intensive self-assessments and the capacity to collect detailed data that is out of reach for most cities across the world.[11] The intent is to leverage advances in evidence and data to enable policy makers, practitioners and researchers to readily assess the key risks facing thousands of cities and their capacity to manage these risks, without being constrained by exacting specificity which can be paralyzing.

Framing the debate

Fragility and resilience are more easily described than defined. Due in part to the diverse epistemic communities involved in studying the two phenomenon, there is disagreement on their respective parameters. The academic and policy treatments of fragility are predominantly at the national scale, often through the lens of political science. Analytical and operational engagement with resilience combines natural, cognitive and social sciences, with an emphasis on psychology, the environment, geography, and the ecosystem. The comparatively limited cross-fertilization across disciplines has meant that despite the emergence of multiple efforts and frameworks, the theorizing and testing of urban fragility and resilience is still in its infancy.

Even so, there are signs that policy and research communities are deepening their understanding of the two concepts. Broadly, the focus on fragility tends to emphasize the real and relative legitimacy, authority, and capacity of state institutions to fulfill their core functions.[12] The inability of government institutions to fulfill these core functions is due to a combination of internal and external risk factors including horizontal inequality, systemic injustice and insecurity, demographic pressures and state legitimacy.[13] A wide range of indices has emerged that are intended to monitor the extent of state fragility.[14] There is also nascent, yet limited, engagement with the regional and subnational dimensions of fragility.[15]

A more robust treatment of resilience is occurring in environmental policy networks and in the natural, cognitive and social sciences. These efforts are often closely aligned with risk reduction and risk management frameworks designed to mitigate natural hazards and disasters.[16] They are also increasingly used within humanitarian, development, and security sectors to shape prevention, delivery and response.[17] The emphasis is on the ability of human and natural systems to cope, adapt, and manage shocks and stresses before, during and, after they materialize. These disruptions can be human-induced though they are more frequently associated with sudden or slow-onset natural disasters and climate-related events. A variety of frameworks

exist that seek to explain the ways in which resilience is built in countries, cities, communities, and households.[18]

This paper re-conceptualizes fragility and resilience at the metropolitan and city scale. It does so in a way that aligns the two concepts more tightly together given their actual and potential interactive effects.[19] This is not as straightforward as it appears. The discussion of fragility is biased toward political, social, and economic risks, and is less sensitive to disaster or climate-related dynamics. Likewise, existing resilience frameworks tend to focus more on ways in which human and natural systems are adaptive to environmental threats rather than the incidence or consequence of political turbulence and economic as well as social disorder. Recognizing the importance of considering multiple risk factors, newer debates on resilience are bringing in the political, social, and economic dimensions to inform analysis.[20]

Recasting resilience and fragility as parallel and interconnected concepts

Contrary to how most existing frameworks conceptualize resilience and fragility, the two concepts are not antonyms.[21] While it is tempting to cast the two constructs on opposite ends of a continuum or two sides of the same coin, the reality experienced by most cities is not that straightforward. In fact, there are no cities that can be described as exclusively fragile or resilient. These are not steady states. Cities typically experience a combination of the two characteristics simultaneously. Indeed, cities can experience acute and chronic forms of fragility due to cumulative risks, while at the same time exhibiting elements of resilience. As such, city fragility and resilience are not mutually exclusive – they can and often do co-exist. In fact, the continued daily function of individuals, households and communities in highly fragile contexts exemplifies and illuminates the parallel and interconnected nature of resilience and fragility.[22]

A city experiences fragility when it is unable to fulfill its core functions owing to the manifestation of internal and external risks. Risks can be political, social, economic, and environmental in character. There are likely thousands of risks that may contribute to fragility, albeit comparatively few that have been proven to correlate with the break-down of functions and services.[23] There are potentially several ways to mitigate fragility. In some cases it may require preventing and reversing identified risks – whether external or internal. It might also include measures to strengthen institutions – both formal and informal – to increase their resilience to risks before, during, and after they occur. Yet, if one accepts the notion that resilience and fragility are not mutually exclusive, it is also conceivable that a city can become more resilient in the absence of purposive measures to reduce fragility.

Resilient cities are those that are able to maintain and potentially improve the delivery of their core functions before, during, and after exposure to shocks and stresses. This is enabled by activating protective qualities and processes at the individual, community, institutional and systems level to engage with hazards and stresses and cooperate with each other to maintain or recover functionality and prosper. It includes characteristics and actions that reduce exposure, limit vulnerability by minimizing the accumulation of pre-existing or additional risks, and enhance coping and adaptive capabilities.[24] At the city level, these protective factors can be institutional in nature, including norms, standards, policies, programs, and organizations. They can also consist of latent socio-economic, infrastructure, and environmental properties that minimize internal and external risks. Nevertheless, if we acknowledge that fragility and resilience co-exist, we must accept that resilience is a dynamic property to which there is no particular end-point or absolute "state".

Resilience can be positive or negative and may in some cases lead to greater fragility.[25] For example, if the resilience of city inhabitants is embedded in hybrid forms of justice, security, and basic service provision facilitated by armed gangs, vigilante associations, or extremist groups to cope with a shock/stress, the authority and legitimacy of city officials and institutions is partially ceded to other actors. While this may help communities cope with a particular crisis, it potentially increases the overall fragility of the city by abdicating the responsibility of city authorities in fulfilling their core functions.

It is important to consider that the degree of urban fragility and resilience is also influenced by broader regional and national factors that shape the extent of risk or enable more protection.[26] Indeed, urban fragility and resilience are also invariably influenced by conditions in rural settings and as such, it is important to consider dynamics in both settings.[27] It stands to reason, then, that changes in the wider environment can generate varying degrees of risk at the city scale. As will be demonstrated in the following sections, how cities choose to govern (manage, mitigate, prevent, adapt to, or ignore) internal and external risks seems to matter significantly in terms of determining the extent of city fragility and resilience.

Factors shaping city fragility

This framework conceptualizes fragility as the accumulation of risks combined with the lack of capacity to cope with these, often interlocking, risks.[28] Coping capacity is measured by inspecting the state of basic service provision and access – including public security, basic health and electricity (see indicators below).[29] When governments and city authorities fail to deliver their core functions, the legitimacy of urban institutions erodes. In extreme situations, services often grind to a halt and the consequences can be

far-reaching. Large parts of a city can become "no-go areas" and experience extreme instability and deprivation. In some cases, city institutions and services breakdown with hybrid and parallel forms of governance emerging and services provided by criminal organizations. Cities characterized as such, can be considered fragile often experiencing violent outcomes.

This framework identifies seven fragility factors. The choice of these factors is based on empirical evidence that (a) they are associated with the likelihood of fragility at the city level (i.e. are correlated with fragility), and (b) the existence of relevant and accessible data to assess the exposure of a city to fragility and measure trends over time across thousands of cities globally.[30] These factors are (1) rapid and unregulated urbanization; (2) income and social inequality; (3) concentrated poverty; (4) unemployment; (5) policing and justice deficits; (6) real and perceived insecurity; and (7) exposure to natural hazards such as droughts, cyclones and floods (see Figure 1 and for a more succinct listing see Annex 1). It is when some or all of these factors manifest when cities become fragile and ultimately susceptible to break down.

Figure 1.
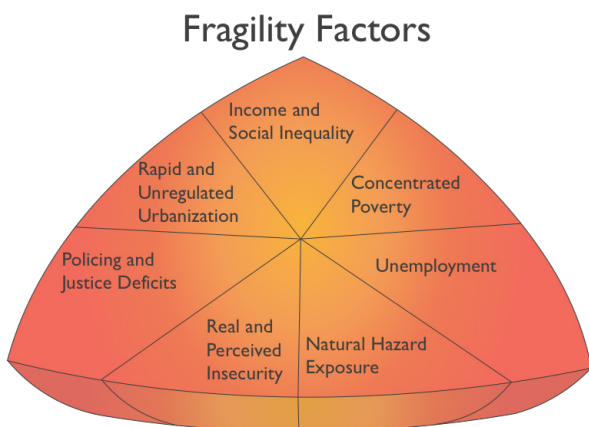
Fragility Factors

These seven factors were chosen based on an extensive review of the literature and existing frameworks of fragility. The choice of factors is in part driven by their link to violence and crime, which in their extreme forms, are considered to be key outcomes or manifestations of fragility. As the OECD States of Fragility Report 2016 puts it, the inability of authorities to control violence (and crime) are some of the "most visible outcomes of a society that has lost its ability to perform core functions."[31] In addition to this, however, this framework is multidimensional as it also recognizes social, economic and environmental factors that link to fragility in a city. This approach enables the framework to take into consideration stressors that don't necessarily lead to violence but cause widespread disaster as a result of a city's inability to deliver on its core functions. A good example is the 2014 Ebola pandemic in Liberia, which did

not necessarily cause an increase in urban violence, but overwhelmed and crippled the health care system (a core function) causing widespread disaster.[32] The rationale for choosing the seven fragility factors is described in more detail below.

Rapid and unregulated urbanization: The speed and unregulated nature of urbanization is a correlate of city fragility by virtue of its link to the probability of crime and violence.[33] Although still a matter of on-going debate, cities with the lowest population growth rates tend to report low levels of violence while those with high growth rates tend to demonstrate high levels of crime and violence.[34] While the correlation between city size and crime rates are not always clear,[35] city growth has a positive and statistically significant effect on crime rates. On average – an increase of 1% in the rate of population growth can increase victimization by up to 1.5%.[36] There are two proposed metrics. The first is the population growth (%) over a ten year period.[37] The second is the size of informal settlements as a proportion (%) of the city area, which is an indicator of unregulated urbanization.[38] Moreover, cities experiencing high rates of growth tend to experience a higher degree of social disorder.[39]

Income and social inequality: The association between crime and inequality is as robust in urban areas as it is across countries.[40] Crime rates are higher in unequal cities[41] and those registering more equal distribution of income and social services (including in terms of access to public health) tend to exhibit fewer social problems including violence. Material and social deprivation in income, property, service provision such as health care, and social status can also expose populations to public health crises, including infectious diseases and higher mortality rates.[42] Three metrics to measure these factors include Gini coefficients,[43] proportion of population lacking access to basic services, and proportion of population without registered legal title.[44] From a basic services perspective, an interesting proxy metric to assess health risks posed to city residents includes air quality, which is recorded by the World Health Organization.[45] Studies have documented a consistent association between long-term exposure to air pollution and an increased risk of mortality around the globe, with particular impact in economically and socially disadvantaged communities.[46]

Concentrated poverty: There is some evidence that the clustering and concentration of poverty – neighborhoods where the poor exceed 40% of the population – is associated with higher rates of crime, underperforming schools, poor housing and health conditions, and incarceration.[47] These areas suffer disproportionately from deprivation in social capital, but are also sites of low public investment, aggressive policing, sub-standard housing, poor quality public health and other services.[48] A possible metric is the percentage of the city population under the poverty rate.

Unemployment: City populations registering a high proportion of unemployment – especially unemployed youth – are susceptible to higher risks of fragility by virtue of the link to violence.[49] More specifically, there are robust relationships between city unemployment and homicidal violence.[50] The availability of standardized city unemployment data is varied. A possible metric is the percentage of male residents in full time employment available in the datasets of regional organizations, which are often disaggregated to the city level. Data on unemployment at the city level is available from the OECD and America Economia. It is also possible to supplement this with national data from the ILO and CEPAL.

Policing and justice deficits: The extent of capacity and confidence in police and justice services are associated with city fragility.[51] A higher number of personnel (law enforcement officers, judges) does not necessarily ensure low crime rates or declining violence.[52] There is more empirical evidence that clearance rates (the proportion of recorded crimes that result in criminal charges) and related impunity of crime is a better predictor of fragility.[53] It is possible to use data on policing and judicial presence (per 1,000 residents) as well as perception-based questions related to confidence in local police forces/judicial systems.[54]

Real and perceived insecurity: A clear expression of city fragility is the extent of real and perceived insecurity. There is frequently a disparity between the incidence of crime and violence and the perception of insecurity that needs to be taken into account. Areas perceived to be highly insecure tend to suffer from an erosion of social capital and social cohesion causing mistrust between neighborhoods and neighbors. This often perpetuates insecurity and fear and can paralyze movement in parts of the city. It can also divert services (public safety and utilities), decrease economic activity and drive away investment.[55] Metrics to measure real insecurity include city homicide rates per 100,000[56] as well as a combined metric counting the incidence of violent riots, conflict, and terrorism.[57] Perceived insecurity includes the extent to which people feel safe walking in the city alone at night.[58]

Natural hazard exposure: City fragility can be exacerbated by the experience/aftermath of sudden shocks and slow onset stresses. Flooding, storm surges, high winds, and extreme weather events are increasing in frequency and intensity and affect people, supply chains, and economic output. For example, a recent review of over 1,300 cities found that 56% are at risk of natural disaster.[59] Many of these risks are especially acute for cities in coastal locations.[60] Indicators to capture these risks include the proportion of city populations living in coastal flood plains, the proportion of city populations affected and killed by natural disasters, economic losses as a percentage of city GDP due to natural disasters. The scientific community is still in the process of developing harmonized data sets at the international level.

Datasets that can be drawn upon include those developed by the United Nations University (the World Risk Index), the International Disaster Database, the Integrated Research on Disaster Risk, and Swiss Re.[61] A number of multi-hazard tools are also being developed (Central America Probabilistic Risk Assessment, Riskscape in New Zealand, the MATRIX in the EU, and HAZUS-MH in the US).[62]

Factors shaping city resilience[63]

Resilient cities are those that are able to maintain and potentially improve the delivery of their core functions before, during, and after exposure to shocks and stresses. The literature on resilience spans multiple disciplines with comparatively limited, yet growing, treatment of cities. Most frameworks and debates associated with factors promoting resilience rely heavily on a theory of change rather than hard empirical evidence.[64] This often limits the verifiability of certain assumptions and can lead to circular and biased reasoning.[65] Datasets that have metrics across a large number of cities are also often focused on vulnerability and exposure to risks rather than protective or resilience factors.[66]

Identifying universal factors that promote resilience is difficult. Because factors that enable resilience can be context specific, pulling out universal ones may lead down the wrong path by ignoring important context specific factors.[67] The subjective construction of resilience can also complicate this process as the perception of one's ability to overcome risks may have as much of an impact as objective factors including income and social protection programs.[68] This makes identifying a standard definition and universal metrics challenging.[69]

Nevertheless, for resilience to be a useful concept, measurement is critical. As the United Kingdom´s Department for International Development supported document outlined in a guidance note on measuring resilience, "if no clear guidelines exist on how to reliably and credibly measure resilience, decision makers will not be able to make informed choices about which resilience interventions are most effective".[70] While even the metrics presented in this framework remain a work in progress, efforts need to be made to come to some agreement on what the most important characteristics of resilience are that can be measured. Below is what this framework puts forward as characteristics that seem to be most important for city resilience and where there is data for measurement.

There are at least seven factors that appear to be most important in shaping city resilience across a range of sectors. These seven factors are depicted in Figure 2. They include: (1) greater income and social equality; (2) effective policing and judicial mechanisms; (3) micro-economic security and social protection; (4) the provision of basic services (which includes public health and critical infrastructure); (5) social cohesion; (6) social networks and social support; and (7)

strong community to government and inter-governmental cooperation (i.e. between municipal and national governments).

Figure 2.

Resilience Factors
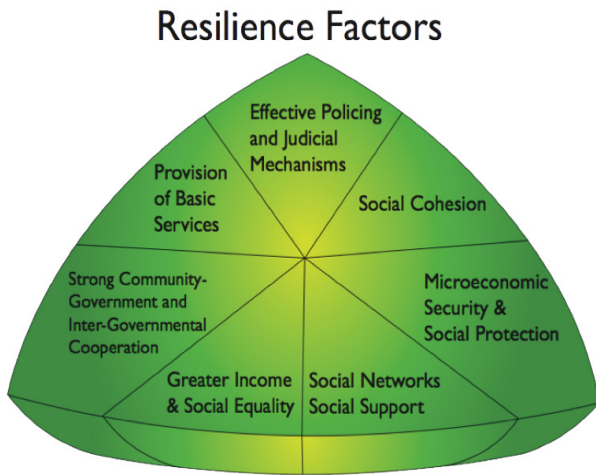
As with the fragility indicators, these seven factors were chosen based on empirical evidence that they are associated with the likelihood of resilience at the city level (i.e. are correlated with resilience) and the availability of data to measure these factors. It must be stated, however, that for some of the resilience factors highlighted above (namely social cohesion, social networks, and strong community-government cooperation), measurement is only possible through proxy metrics. Their inclusion in the framework, however, is important given their repeated study and association with resilience.[71] The rationale for choosing these factors is briefly described below:

Greater income and social equality: Just as inequality can lead to fragility, greater equality can protect against the risks that cities face. Greater resource equity (or less income inequality), for instance, has been proven to associate with higher levels of resilience to numerous types of shocks, including natural disasters.[72] Greater equality may also serve as a marker for various other factors generally associated with resilient cities such as inclusive and accountable government that is attentive to investing in coping and adaptive capacities. The Gini coefficient remains useful in this regard as well. Further metrics are listed in Annex 1.

Effective policing and judicial mechanisms: By the same mechanisms that a policing and judicial deficit can contribute to fragility, the presence of these factors as responses to urban violence can contribute to resilience. Public trust in the police has been linked with greater public cooperation with justice, greater compliance with the law and enhanced institutional legitimacy.[73] Competent and trustworthy police and judicial systems that are transparent and accountable have been identified in case studies as resilience factors in urban areas exposed to chronic

violence.[74] The metric above for police per 100,000 may be an imperfect but useful proxy while trust in the police and judicial system is more important.[75]

Microeconomic security and social protection: Access to certain social protection schemes, savings, insurance, and availability of credit can assist households and neighborhoods grapple with shocks of various kinds and reduce negative coping mechanisms. Social protection programs, including those specifically designed for displaced persons, have proven effective.[76] As markets and affordability drive access to goods and services in cities, microfinance and economic protection services tend to enhance the ability of individuals and communities to access these goods and services.[77] Potential metrics could include the percentage of population or poorest quintile covered by social protections schemes available through the World Bank ASPIRE dataset. In the United States, the Department of Human Services (DHS), in cooperation with the National League of Cities, have provided some models of how to measure financial inclusion at the city level.[78] Further metrics potentially available in unstructured data sets are listed in Annex 1.

Provision of basic services: Access to basic services as a marker of effective urban development contributes to resilience by protecting against shocks/stress and enabling faster recovery.[79] This metric can be measured as a percentage of people with access to public healthcare, piped water or improved sanitation (flushing toilets). Access to improved sanitation often lags farther behind access to piped water and could serve as a more sensitive metric that is available from UN-Habitat for many cities.[80] Likewise, critical infrastructure is necessary to basic city functions and services even if it is not fully examined in the literature due to its accepted necessity. The quality of this infrastructure, investments on maintenance and their ability to withstand stress scenarios is a reflection of the ability to provide basic services. Metrics in this realm can include electricity interruption frequency and length, water service interruptions and water loss available in the World Council on City Data. A further key factor to ensure basic services provision during and in the wake of a disaster is surge or absorptive capacity. Associated metrics might relate to their current coverage, quality, robustness, and redundancy for likely stress scenarios.[81] More specific measures for disaster preparedness include the percentage of acute care facilities/trauma centers/doctors per 100,000 – available from WHO and USAID DHS datasets or shelter capacity (shelter beds available or surge capacity from UNDP datasets or unstructured city data) and first response capacity (per capita active and reserve police, emergency medical services, fire-fighters, and average time to response).[82] The percentage of municipal expenditures for fire, police and EMS are also useful.[83]

Social cohesion: Relevant in many resilience contexts, social cohesion has been highlighted by many frameworks as a key capacity to cope with shocks and stresses including violent conflict.[84] Greater social cohesion within and between groups allows various shocks to be absorbed thereby mitigating factors that can exacerbate conflict in times of stress and also mitigating the impact of exposure to violence.[85] Violence undermines the trust and social cohesion that is vital to resilience.[86] Evidence from South Africa provides a statistical link between social cohesion and community resilience to violence.[87] The lack of an accepted definition of social cohesion and readily available and widely collected metrics at the city level complicates data collection. However, emerging scholarship has highlighted a range of proxy metrics that enable measurement. These include metrics of social capital, social inclusion, and social mobility.[88]

Social networks and social support: Independent from the social cohesion described above, the social supports available for and accessible to individuals, households, and communities have been highlighted as resilience mechanisms in fragile urban contexts as well.[89] The link between collective efficacy in communities (the ability of community members to control the behavior of individuals and groups in the community) and crime reduction is also clear.[90] Evidence is also emerging indicating that cognitive behavioral therapy, which trains criminally engaged men to better manage emotions, practice non-aggressive responses and develop non-criminal social networks, can help reduce crime and recidivism.[91] As stated previously, these can come in positive or negative forms – positive if they reinforce inclusive community identities and negative if they do not. Evidence specifically from cities such as Mogadishu and Johannesburg has demonstrated the value of social networks for resilience.[92] While this factor may be better assessed through qualitative case-study based research, possible proxy metrics in unstructured data may include the number of civic organizations, social clubs, recreational groups, arts societies, service associations, and other non-profits registered as a ratio of population size.[93] A further delineation could be made on how many of these are volunteer-based or perform a community service function.[94]

Strong community-government and inter-governmental cooperation (between municipal and national governments): In urban areas with chronic violence, productive cooperation between citizens as a collective and the government has been found to correlate with resilience to stresses and shocks. In Honduras, for example, cities with underlying poverty and chronic violence that exhibited greater degrees of cooperation between communities, NGOs and the government in the aftermath of Hurricane Mitch demonstrated greater degrees of resilience.[95] Proxy metrics that may exist for many cities in unstructured datasets are the ability to launch direct democracy through petition or the number of signatures required to do so relative to the population size of city.[96] Others may include voter participation rates or electoral strength of the governing party. While still untested, there are also a host of metrics that can be considered for this factor. A major category of these relate to the key characteristic of urban risk governance where cooperation between various orders of government has been mentioned as essential.[97] These include, for example, disaster management plans (presence of a disaster plan, disaster management office, or official), early warning systems (presence of an early warning system and integration into a city management plan), training and simulation exercises (existence and regularity for likely scenarios), and federal/regional/municipal resources (amount of funding accessible from the federal/regional level for recovery as a percentage of city GDP and percentage of per capita budget for disaster response). Significant research and time is nevertheless required to gather these metrics.

Applying the Framework: Mapping fragile cities

Any effort to map the extent of fragility and resilience of cities will suffer from limitations. Part of the challenge is innate to cities themselves – they are hyper-complex systems. Modeling the interconnections between underlying risk and protective factors will require generating a robust data sample of the above-mentioned fragility and resilience factors. Moreover, describing, much less predicting, the manifold ways that risk and protective factors interact with complicated formal and informal institutions and systems requires (at a minimum) a mixed method approach.[98]

There are also basic challenges to assessing city fragility and resilience. For one, it is often difficult to determine the geographic or administrative metropolitan unit as the definition of cities varies across different datasets. Moreover, there are likely unobserved heterogeneity issues. Diversity and heterogeneity within and between cities are very real. These issues force contextualization and limit the ability to extract, and thus interrogate, universal factors and metrics. The multidimensional nature of fragility and resilience and the complexity of cities along with the nascent state of evidence make it difficult to draw causal links in favor of associations. Finally, there are very significant questions related to the availability, coverage, quality, and comparability of structured and unstructured data.[99]

As the evidence base builds and data improves, a more accurate and precise understanding will emerge, refining this framework. While recognizing the limitations that these realities pose to our findings, an attempt has been made to partially apply the framework presented above in order to assess whether it is possible to chart the distribution of fragility across thousands of cities. To do so, the Igarapé Institute and several partners developed a database mapping out the seven city fragility factors mentioned earlier. Due to reasons of time and resources we have not mapped the seven resilience factors as of yet.

The dataset features information on 2,100 cities with populations of 250,000 or more – half of which are located in Asia (see Figure 3). It assesses cities across the seven factors using eleven variables, including city population growth rates, unemployment, income inequality, access to basic services (electricity), homicide rates, terrorism, conflict events, and natural hazards (including cyclones, droughts, and floods).

Figure 3. Distribution of cities in the sample (total number/ percentage, n=2,100)
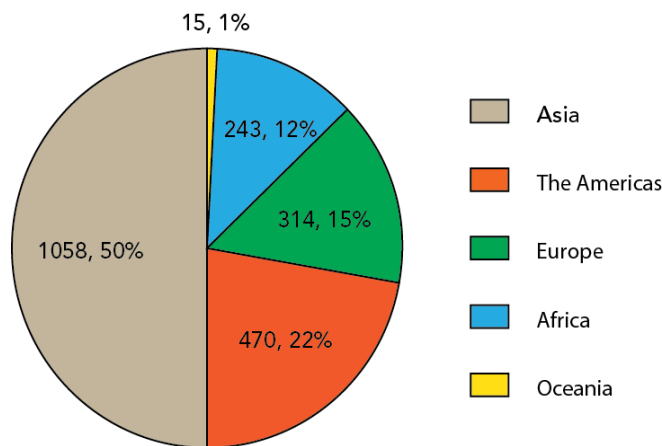
The authors examined a wide range of datasets to retrieve select information. These include structured data retrieved from public and private sources including national statistical offices, multilateral and bilateral agencies such as the OECD, UN Habitat, UN Office for Drugs and Crime, World Bank, and World Health Organization, as well as other major academic and private-led initiatives. The Institute also consulted unstructured data from research projects such as GDELT (http://www.gdeltproject.org/) and the Global Terrorism Database (https://www.start.umd.edu/gtd/) as well as other sources. Close to one hundred databases were examined.

There are hundreds of risks facing cities, yet there are comparatively few risks that are correlated with the fragility of city institutions. The dataset is thus limited to a shortlist of eleven indicators that are measures of the seven fragility factors mentioned earlier. Specific city-based data was retrieved when it had satisfactory level of coverage. City-level data was collected for all variables and where specific city data records were unavailable from any alternate source, national urban data was used.[100]

Each of the eleven selected variables is standardized to a scale of 1-5 (with 0 indicating low fragility and 5 indicating high fragility).[101] At the center of the dataset is a city fragility score. The score is formed after combining all eleven variables and creating a standardized and un-weighted composite (between

0 and 5) for each city. In practice, however, there were no cities with scores of 0-1 or 4-5 with all cities falling between 1-4. To be assigned a fragility score, there must be at least seven of the eleven indicators included. Low fragility is defined as having a score of 1-2, medium fragility is 2-3, and high fragility is 3-4 (including decimal places).

These eleven variables were then tracked to measure city fragility across 2,100 cities. The variables and their data sources include:

1. **Urban population growth:** Speed of population growth over a 10 year interval. Data available for 1,666 cities from UNDESA with the other 434 supplemented with national urban data from the World Bank.

2. **Income inequality:** The category is measured by the Gini coefficient - the distance in income between the highest and lowest quintile of the city population. It is available for 664 cities from UN-Habitat with the remaining data for 1,105 cities from a range of national statistics office sources. There are 331 cities with no information from any source.

3. **Unemployment rate:** Extent of unemployment as share of total labor force. Available for 785 cities including from the OECD and America Economia, of which 842 were supplemented with national data from the ILO and CEPAL. There are 473 cities for which no data is available from any source.

4. **Homicide rate:** The prevalence of intentional homicide per 100,000 in a given city population is available from the Homicide Monitor. Specific city data is available for just 469 cities. The remaining 1,631 cities are not included.

5. **Conflict-related events:** The intensity of reported "violent" events on the basis of a big data mining system of 1,000 media outlets from around the world collected by GDELT. Information is available for 1,537 cities (there is no data available for 563 cities).

6. **Terrorist killings:** The registered incidents of terrorist-related killings based on lethal violence due to declared ideological motivations collected by GTD. Information is available for all 2,100 cities.

7. **Access to services:** The accessibility to services is measured using a proxy - the proportion of the population with access to electricity (other variables such as sanitation, toilets, floor quality of houses lack adequate coverage). Electricity coverage is available for all 2,100 cities from UN Habitat and the World Bank (African cities) and other World Bank values.

8. **Air quality:** This indicator was used as a proxy to assess effective service delivery, particularly with respect to measuring the health risks posed to city residents. More specifically, air quality is an indicator of the ability of cities to provide quality energy sources to its citizens. It is measured in terms of the annual mean concentrations of air quality (particulate matter of less than 2.5 microns), which is recorded by the WHO. Data is available for 1,883 cities in total – of which 1,047 cities were ascribed a "city average" based on national rates. There are 217 cities with no data.

9. **Exposure to natural hazards:** At risk cities were determined by calculating exposure to three natural disaster categories - cyclones, droughts and floods - over a population grid - with primary data supplied by SEDAC and CIESIN of the Earth Institute. Igarapé Institute established data for 1,968 cities. No data was available for 132 cities across each type of hazard.

10. **National fragility:** The countries ranked as "fragile" using the World Bank CPIA score and the presence of an international or regional peace operations. This accounts for 33 specific countries in 2016 according to the World Bank.

11. **National armed conflicts:** The countries in which there is an ongoing "armed conflict", itself defined as an "armed incompatibility" involving armed forces of two or more parties of which one is a government. There are 50 conflicts as of 2015 according to UCDP.

These results were compiled into a fragile cities data visualization (available at: fragilecities.igarape.org.br), which provides an interactive platform with information on these 11 variables in 2,100 cities (Figure 4). Readers are invited to visit this data platform to explore fragile cities according to their fragility score and across all eleven descriptive filters. This platform allows users to plot base data on three axes to discern correlations between city variables and allow more critical engagement with the underlying data.[102]

Figure 5. Distribution of fragility in cities across the sample (n = 2,100)
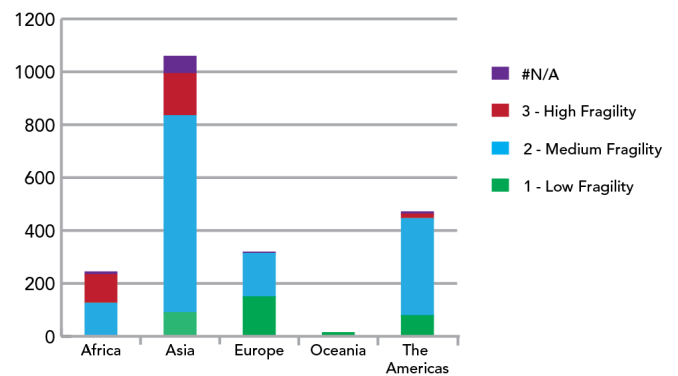

A review of the dataset finds that fragility is widely distributed across cities (see Figure 5). Of the sample of 2,100 cities, roughly 14% (284) can be considered very fragile (3-4). Another 66% (1404) of the cities report average levels of fragility (2-3). And 16% (328) of all cities report low fragility (1-2). The final 4% (84) of the cities had insufficient

Figure 4. The distribution of fragile cities globally
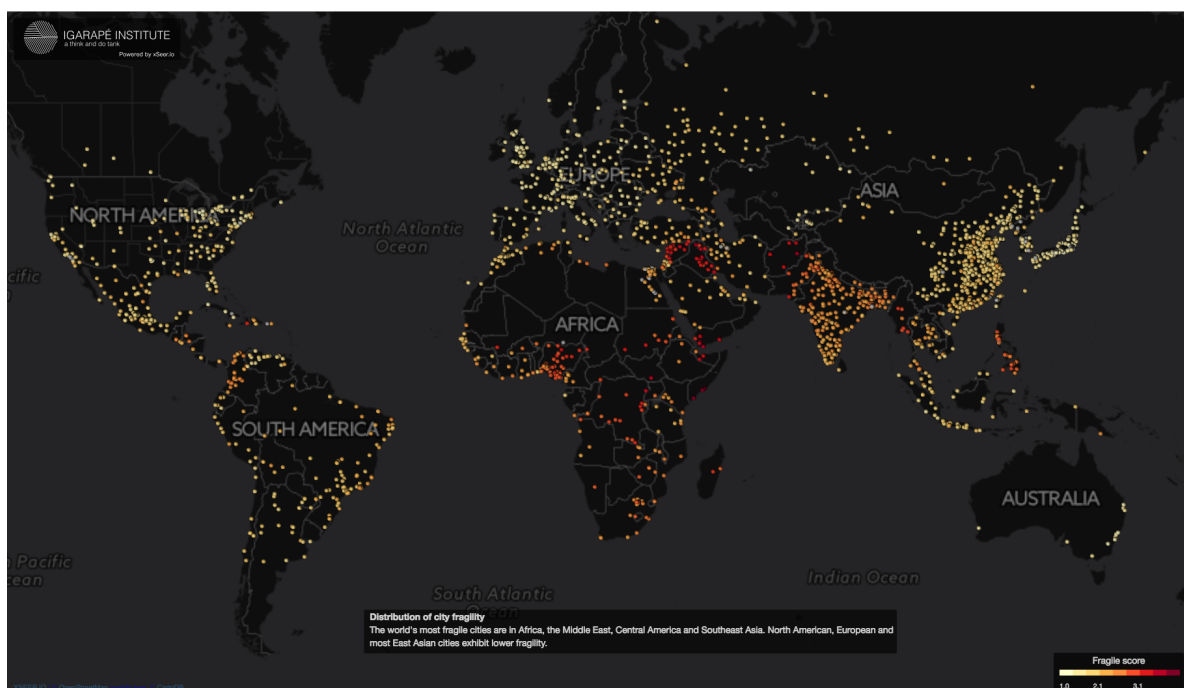
data for any ranking and thus were not ascribed a score. Unsurprisingly, given the associated challenges of national fragility and conflict, virtually all of the most fragile cities are clustered in Africa and Asia, accounting for 93% of all high risk (3-4) cities. Indeed, roughly 44% of all African cities are considered highly fragile and 51% experience medium levels of fragility. There are no low fragility cities in Africa. By comparison, Asia has roughly 70% of its cities classified as medium fragility, with 15% experiencing high levels of fragility (see Figure 6).

Figure 6. Distribution of city fragility - number by region (n = 2,100)
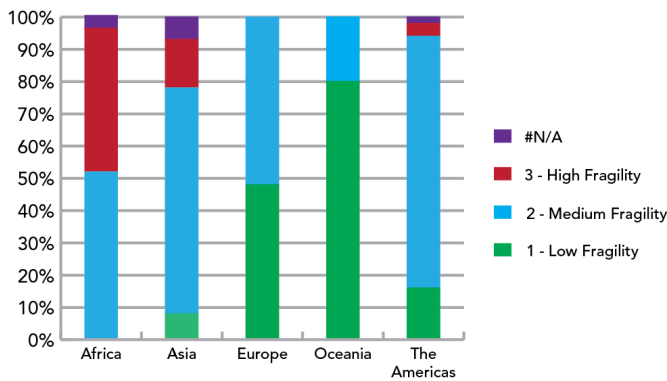
The regions with the highest proportion of low city fragility are in Europe, Asia, and the Americas. Significantly, there are no highly fragile cities in Europe, while 52% of its cities experience medium fragility and 47% are low fragile. The Americas – including North, Central, and South America – features the highest number of cities with medium levels of fragility (78%) and just 4% with high rates of fragility. Surprisingly, the least fragile cities are in the South Pacific, partly due to the comparatively limited number of large cities.

Another way to understand the distribution of city fragility is by examining the average composite score across regions. Africa has the highest fragile city index average of 2.48 (out of 4). Next comes Asia with 2.08 followed by the Americas with 1.87. Cities in in Europe (1.52) and in Oceania (1.20) have the lowest average composite scores.

According to the mapping exercise, the most fragile cities in the world are concentrated in Africa, the Middle East and Central Asia (see Figure 7). Mogadishu (4), Kismaayo (3.9) and Merca (3.9) – all Somalian cities – constitute the top three, followed by Kabul (3.7), Mosul (3.7), Aden (3.6), Kirkuk (3.5), Juba (3.5), Ibb (3.5, Yemen), and Kunduz (3.4).

Meanwhile, the cities with the lowest fragility scores are largely concentrated in the United States, Japan, Australia, Norway, Serbia and Uzbekistan. For example, Sarasota,

Syracuse, and Ann Arbor (all 1.1) figure at the top of the list. Likewise, Bournemouth (1.1), Sakai (1.1), Novi Sad (1.1), Canberra (1.1), Oslo (1.2), and Samarkand (1.2 Uzbekistan) are also low risk. Part of the reason for this is that the latter set of cities experience no conflict, low unemployment rates, minimum hazard exposure, full electricity coverage, and other ostensibly positive variables.

Figure 7. Ranking city fragility scores - Top 15

Rank	City	Country	Fragile cities score
1	Mogadishu	Somalia	4
2	Kismaayo	Somalia	3.9
3	Merca	Somalia	3.9
4	Kabul	Afghanistan	3.7
5	Al-Mawsil (Mosul)	Iraq	3.7
6	Aden	Yemen	3.6
7	Kirkuk	Iraq	3.5
8	Juba	Republic of South Sudan	3.5
9	Ibb	Yemen	3.5
10	Kunduz	Afghanistan	3.4
11	Bunia	Democratic Republic of Congo	3.4
12	Al-Basrah (Basra)	Iraq	3.4
13	Baaqoobah	Iraq	3.4
14	Hargesya	Somalia	3.4
15	Al-Raqqah	Syrian Arab Republic	3.4

Yet, it is important to point out that high levels of city fragility are not necessarily confined to low- or even medium-income settings. While there are no "high fragility" cities (scoring 3-4) in high-income countries, there are over 40 cities with high fragility in upper middle-income settings (for example Belo Horizonte (Brazil), Wenzhou (China), and Cucuta (Colombia)), 194 in lower-middle income settings, and 50 in low-income settings. Likewise, there are no low fragility (1-2) cities located in low-income settings. However, there are 273 low fragility cities in high-income settings, 43 in upper middle-income settings, and 7 in lower-middle settings. There is, however, a comparatively strong relationship between high income and low city fragility and low income and comparatively higher levels of city fragility.

Conclusions

We live in an era of dramatic urban growth. Over half of the world's population lives in urban areas and this figure is projected to increase to two thirds in the next fifty years.[103] The concentration of people, power, and wealth in cities

creates many possibilities for tackling some of the world's most pressing problems. For instance, there is a good case to be made that the fight for sustainable development may be won or lost in cities.[104] At the same time, urban areas are emerging as epicenters of multi-layered violence and extreme vulnerability.[105] Many cities are facing challenges that range from climate change to extreme poverty to high homicide rates. Today's cities account for at least 70% of total worldwide greenhouse gas emissions, they are home to the majority of the world's poor, and register higher homicide rates than rural areas.[106]

Policy makers and organizations such as the United Nations are starting to wake up to this urban reality, yet virtually nothing is known about the risks experienced by the majority of the world's cities. This framework provides an alternative approach. It suggests that city fragility can be measured empirically by inspecting the key risks that can push a city into a state of dysfunction. Likewise, resilience can be assessed through the identification of key factors promoting coping, recovery and adaptation that help cities maintain their core functions in the wake of crisis. To that end, presented were seven fragility and seven resilience factors.

While data limitations remain, an attempt was made to map the seven fragility factors and associated metrics across thousands of cities worldwide. The results indicate that city fragility is more widely distributed than initially assumed. In fact, no city is immune. All cities are fragile to a lesser or greater degree. While it is true that most fragile cities are concentrated in Africa and Asia, they are not necessarily confined to low or even medium income settings. In fact, there are over forty highly fragile cities in upper middle-income settings.

Cities that invest in mitigating key risks today are most likely to thrive in the future. Resilient cities tend to embody three characteristics: inclusivity, security and effective risk governance. Cities that build inclusive public spaces, invest in areas of concentrated poverty, develop more predictable public transport, that have police services that are trusted and that develop disaster mitigation plans and strengthen social networks tend to be more resilient to shocks and stresses. Investments that reduce exclusion, promote security and enhance the capacity of authorities and citizens to prepare for and respond to disaster and violence result in a more resilient city.

There are still many areas to improve the measurement of fragile and resilient cities. As indicated early, any attempt to measure fragility and resilience across cities should also be accompanied by qualitative and quantitative studies at the city level to better understand who is vulnerable to what risk and also to validate/correct the results of this analysis. Furthermore, there are still sizeable gaps in relation to the selected metrics – notably homicide, unemployment, and income inequality. Comparable metrics and datasets for social cohesion, social networks and community-government cooperation are sorely needed as well. Data holes must be plugged. Likewise, there are additional variables that may also usefully track fragility and resilience that are not isolated to cities. For example, the density (or paucity) of inter-city networks measured by airports and flights may help illuminate city fragility or resilience with the degree of interconnectivity.[107]

The growing variety of structured and unstructured data should also put us in a better position to assess city fragility and resilience into the future. This framework and its associated data visualization is a step in that direction. City authorities, national governments, multilateral organizations, the private sector and researchers will now have a way to readily examine fragility and resilience at the municipal level. It is hoped that this resource will enable them to understand which risks affect which cities most and arrive at evidence based decisions about how to reduce, and potentially reverse, key risks and support protective measures.

Annex 1: Matrix of Possible Fragility and Resilience Factors and Indicators

Fragility Factor	Indicator
Rapid and Unregulated Urbanization	Population growth (%) over 10 years
	Size of informal settlements as a proportion (%) of the city area
Income and social inequality	Gini coefficients
	Proportion of population lacking access to basic services
	Annual mean concentrations of air quality (particulate matter of less than 2.5 microns), recorded by the WHO as a proxy for access to quality and safe energy sources
	Proportion of population without registered legal title
Concentrated Poverty	City population under the poverty rate
Unemployment	Percentage of male residents in full time employment. Percentage of unemployment in cities
Policing and Justice Deficits	Policing and judicial presence (per 1,000 residents)
	Public confidence in local police forces and judicial systems
Real and Perceived Insecurity	City homicide rates (per 100,000 residents)
	Combined metric for incidents of riots, conflict, and terrorism
	Perceived insecurity in the city
Natural Hazard Exposure	Proportion of city population living in coastal flood plains
	Proportion of city population affected by weather related disasters
	Economic losses as a percentage of city GDP and mortality losses from disasters as a percentage of city population

Resilience Factor	Indicator
Greater Income and social equality	Gini coefficients
	Proportion of population lacking access to basic services
	Proportion of population without registered legal title
Microeconomic Security & Social Protection	Percentage of population or poorest quintile covered by social protection schemes
	Percentage of population with access to a bank account
	Proportion of population enrolled in social risk management, social safety net programs, pensions (CPIA Q10 guideposts)
Provision of Basic Services	Percentage of people with access to piped water or improved sanitation
	Infant mortality and life expectancy
	Education/school enrollments and completion
	Percentage of acute care facilities/trauma centers/doctors per 100,000
	Proportion of population without registered legal title
Effective Policing and Judicial Mechanisms	Policing and judicial presence (per 1,000 residents)
	Public confidence in local police forces and judicial systems
	Government effectiveness and control of corruption
Social Cohesion	There is a lack of quantifiable metrics for this factor – proxies highlighted in the literature include blood donations, the inverse of property crime and violence, or direct measures of income and social equality as outcomes of good social cohesion
Social Networks Social Support	There is a lack of quantifiable metrics for this factor - proxy metrics in unstructured data may include the number of civic organizations, social clubs, recreational groups, arts societies, service associations, and other non-profits registered as a ratio of population size
Strong Community-Gov't Cooperation	There is a lack of quantifiable metrics for this factor - proxy metrics that may exist for many cities in unstructured datasets are the ability to launch direct democracy through petition or the number of signatures required to do so relative to the population size of city. Additionally the presence of a disaster plan, disaster management office, or officials, the presence of an early warning system and integration into a city management plan, the existence and regularity of training and simulation exercises, and the amount of funding accessible from the federal/regional level for recovery as a percentage of city GDP and percentage of per capita budget for disaster response

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Endnotes

1. Credit also goes to Louise Bosetti, Alexandre Ivanovic, Menaal Munshey and Katherine Aguirre for their contributions to this project. The authors are grateful for financial support provided by the United Nations-World Bank Fragility and Conflict Partnership Trust Fund.

2. de Boer, J., Muggah R. (September 2015), "The sustainable development fight will be won or lost in our cities," World Economic Forum, Agenda https://www.weforum.org/agenda/2015/09/the-fight-for-sustainable-development-will-be-won-or-lost-in-our-cities/

3. de Boer J., (March 2015), "The Fragile City: The Epicentre of Extreme Vulnerability," United Nations University Centre for Policy Research http://cpr.unu.edu/the-fragile-city-the-epicentre-of-extreme-vulnerability-2.html

4. There was insufficient data for the remaining 4% of cities for them to be included in the sample.

5. See for instance de Boer, J., and Patel, R., "The Future of Resilience: 2025 and Beyond," in International Federation of the Red Cross and Red Crescent Societies, World Disasters Report, Geneva www.ifrc.org/wdr2016. Also see Peter Maurer in "Urban warfare has altered the nature of humanitarian work, says Red Cross Chief," The Guardian, 13 November 2015 http://media.ifrc.org/ifrc/publications/world-disasters-report-2016/chapter-7

6. See for instance Muggah (2012)

7. For example the IFRC's Characteristics of a Resilient Community, the City Resilience Index produced by ARUP being used by the 100 Resilient Cities Initiative of the Rockefeller Foundation as well as UN-Habitat's City Resilience Profiling Tool.

8. UNU-CPR has mapped 35 conceptual frameworks for resilience and fragility (including 11 indexes and 3 databases) that are currently being used to support programming, policy, decision-making, and public awareness.

9. See Sturgess, P. (2016)

10. See Muggah (2015b) and Patel (2016).

11. For example the City Resilience Index produced by ARUP and being used by the 100 Resilient Cities initiative of the Rockefeller Foundation or UN-Habitat's City Resilience Profiling Tool. Both are excellent, innovative tools but are difficult to implement in contexts of fragility where the capacity to collect data remains weak. The difficulty of collecting data at the city level was also amply demonstrated by the work of David Simon et al (2015). "Developing and testing the Urban Sustainable Development Goal's targets and indicators – a five city study," Environment & Urbanization http://eau.sagepub.com/content/early/2015/12/17/0956247815619865.full.pdf. This study underscored key challenges associated with collecting data for SDG 11 for 6 cities.

12. See Bosetti, Ivanovic, and Munshey (2016) and Muggah (2015a) for review of fragility, resilience, and risk frameworks. Also see, for example, World Bank (2015, 2014, 2011) and OECD (2015, 2014). Also see Jörn Grävingholt, Sebastian Ziaja and Merle Kreibaum, "Disaggregating state fragility: a method to establish a multidimensional empirical typology." Third World Quarterly, 36:7, 1281-1298, (2015) DOI:10.1080/01436597.2015.1038340. Also see Charles Call, "Beyond the 'failed state': Toward conceptual alternatives," European Journal of International Relations, June 2011 17: 303-326, pp. 306. Gisselquist, R.M, 2015, "Varieties of fragility: implications for aid," Third World Quarterly, 36:7, pp. 1269-1280.

13. See 2011 World Development Report: Conflict, Security and Development, World Bank.

14. See Muggah (2015a, 2015b) for a review of fragile state indices.

15. The World Bank (2015) describes new approaches to measuring both regional and subnational fragility combining CPIA scores with other factors.

16. See Bosetti, Ivanovic, and Munshey (2016) for review of fragility, resilience and risk frameworks. Also see: http://www.iisd.ca/download/pdf/sd/ymbvol141num1e.pdf

17. See for example: World Development Report 2014, Risk and Opportunity: Managing Risk for Development,

18. See Patel (2016) for a comprehensive assessment of resilience frameworks.

19. See de Boer (March 2015) for a general overview of the relationships between fragility and resilience.

20. See for example the OECD's 2016 States of Fragility Report.

21. See for example the 2014 African Development Bank Group Strategy for "Addressing Fragility and Building Resilience in Africa," which characterizes fragility as "the opposite side of the coin to state resilience" (http://www.afdb.org/fileadmin/uploads/afdb/Documents/Policy-Documents/Addressing_Fragility_and_Building_Resilience_in_Africa-_The_AfDB_Group_Strategy_2014%E2%80%932019.pdf) or the 2008 OECD note on "Concepts and Dilemmas of State Building in Fragile Situations: From Fragility to Resilience," http://www.oecd.org/dac/governance-peace/conflictfragilityandresilience/docs/41100930.pdf . The European Union adopts a similar approach that is slightly more nuanced which states that "fragility and resilience should be seen as shifting points along a spectrum."

22. While overlaps and interconnections exist, as the work of Matyas and Pelling (2015) have pointed out, resilience is not the opposite of fragility and they are best understood as separate concepts. Viewing them as two sides of the opposite coin leads to, in their view, "unproductive circular reasoning".

23. See Muggah (2015a, 2015b).
24. UNU reviewed more than 35 indices of fragility, resilience, and risk. These frameworks were developed across various disciplines. A wide range of metrics were identified that are included in this conceptual note.
25. See Davis and Muggah (2012).
26. See the work of the LSE on cities and fragile states in 2010. Consult http://www.lse.ac.uk/internationalDevelopment/research/crisisStates/Research/cafs.aspx.
27. See Beall, Goodfellow, and Rodgers (2011).
28. This is similar to how the forthcoming OECD States of Fragility Report 2016 conceptualizes fragility. One author (de Boer) was on the expert advisory group to the OECD framework, which is scheduled to be released in November 2016 http://www.oecd.org/dac/conflict-fragility-resilience/states-of-fragility-2016.htm
29. Quantitative measurement of city fragility and resilience should, where possible, be accompanied by qualitative or mixed method approaches. This is particularly important in light of on-going processes to identify the most at risk cities to natural and human made disasters at the United Nations. The adoption of Sustainable Development Goal 11 on "Making Cities Inclusive, Safe, Resilient and Sustainable" provides additional impetus to this exercise as States begin to focus their efforts on cities that are most in need of support (http://www.un.org/sustainabledevelopment/cities/)
30. Currently, most initiatives designed to measure fragility are still aspirational in nature, or focused reservedly on a small selection of proxy metrics at the national scale. The authors recognize that one of the shortcomings of identifying universal factors is that it can mask unique risks that may face particular cities. To uncover these risks localized case study analysis would be required and is encouraged. The purpose of this framework, however, is to assess the comparative risks faced by cities around the world, and in so doing to identify those that are likely most at risk of fragility.
31. This section is also informed by discussions with the team drafting the OECD's States of Fragility Report 2016. See also Claire Vallings and Magui Moreno-Torres (2005). "Drivers of Fragility: What makes states fragile?" PRDE Working Paper No. 7 Department for International Development, UK. http://ageconsearch.umn.edu/bitstream/12824/1/pr050007.pdf. This notion is backed by Goal 16 of the 2030 Agenda for Sustainable Development, which recognizes that sustainable development cannot be realized without peace and security. See the 2030 Agenda for Sustainable Development https://sustainabledevelopment.un.org/post2015/transformingourworld
32. It is worth noting however that the disastrous attempt to quarantine the entire Liberian slum of West Point by Liberian security forces, which fenced in an estimated 75,000 people did lead to increased violence and a spike in food prices while having no impact on containing the disease. See Eba PM (December 2014). "Ebola and human rights in West Africa," The Lancet. 13;384(9960):2091-3.
33. See http://www.ncbi.nlm.nih.gov/pubmed/22591767.
34. See Braithwaite, J. (1975) "Population Growth and Crime," Australian and New Zealand Journal of Criminology, 8.1. Also see Muggah R., (2012) and Marc et al (2010)
35. See Nolan (2004). Also see Chamlin M. B and Cochran J. K. (2004)
36. In theory, rapid urban growth may raise crime for many reasons, including a higher concentration of richer individuals attracted by rising opportunities in cities, congestion of law enforcement, and social services, massive unemployment, and increasing poverty. See Gaviria and Pages (2002).
37. See http://data.worldbank.org/indicator/SP.URB.GROW. See also Urban Population Growth Rates at World By Map - http://world.bymap.org/UrbanPopulationGrowthRates.html. See also http://www.iied.org/cities-interactive-data-visual.
38. See http://www.cityindicators.org/themes.aspx#Governance.
39. See Urdal, H. and Hoelscher, K. (2009) and Urdal, H. (2011)
40. See Daly, Wilson, and Vasdev (2001) and Fajnzylber, Lederman, and Loayza, (2002). Also see http://www.citylab.com/politics/2014/02/what-most-violent-nations-world-have-common/6015/; and http://www.citylab.com/crime/2012/12/geography-us-gun-violence/4171/ and http://www.citylab.com/crime/2013/10/how-chicago-points-growing-inequality-urban-violence/7103/
41. See Glaeser et al (2009) available at http://scholar.harvard.edu/files/resseger/files/glaeserressegertobiojrs.pdf. Arguing that the link between income inequality and homicide was "mixed" Aki Roberts and Dale Willits assessed income inequality measures against homicide in 208 large US cities and concluded that the two were correlated highly regardless of what measures of inequality one used. See Roberts A. and Willits, D. (2015)
42. For instance, studies have consistently demonstrated how communities of low socio-economic status often experience greater effects of air pollution representing a strong factor in health inequalities and the risk of mortality. See for instance Thurston, G.D. et al (2016) available at: http://ehp.niehs.nih.gov/1509676/ and Cesaroni, G. et al (2013) http://ehp.niehs.nih.gov/1205862/ and WHO (2010) http://www.euro.who.int/__data/assets/pdf_file/0003/78069/E93670.pdf

43. For example, cities with Gini inequality exceeding 0.4 are especially vulnerable. See http://www.unhabitat.org.jo/en/inp/Upload/2233036_pages%20from%20Report-Englishrd-2.pdf and in particular page 23.

44. See Klovers (2006).

45. http://www.who.int/phe/health_topics/outdoorair/databases/cities/en/

46. There is very broad consensus around this finding. See for instance Thurston, G.D. et al (2016) available at: http://ehp.niehs.nih.gov/1509676/ and Cesaroni, G. et al (2013) http://ehp.niehs.nih.gov/1205862/ and WHO (2010) http://www.euro.who.int/__data/assets/pdf_file/0003/78069/E93670.pdf

47. See Galster G.C. (2010) also see Valdez A., Kaplan C.D., and Curtis RL. Jr. (2007)

48. See Jargowsky (2003), Hipp and Yates (2011) as well as Sampson R. J et al (2002)

49. For example, populations with over 40% of their (male) population under the age of 30 are more predisposed to organized violence. See for example Raphael and Winter-Ebmer (2004) from the US. Also see Carmichael F. and Ward. R. (2001). Researchers have also noted how the effect of youth unemployment on crime is mediated and moderated by variables such as monetary dissatisfaction, negative subjective perceptions, the lack of state support, a decrease in social control, and prolonged homelessness which can lead to greater participation in criminal activities. For more see Baron, S.W (2008).

50. There are also strong relationships between education and homicidal violence, with highly educated metros tending to feature lower levels of all types of gun-related death and violence. See https://nextcity.org/daily/entry/urban-nation-narrowing-the-gun-violence-map and http://www.citylab.com/crime/2012/12/geography-us-gun-violence/4171/.

51. A large number of studies have talked about the importance of "procedural justice" in fighting crime. These studies find a positive correlation between trust in police and their practices and a greater willingness to help the police fight crime. See for instance Reisig, M. (2009) who looked at the case of Jamaica.

52. See Bradford (2011) https://www.justiceinspectorates.gov.uk/hmic/media/police-numbers-and-crime-rates-rapid-evidence-review-20110721.pdf Also see Kleck, G., and Barnes, J. C. (2010)

53. See for example Sampson, R.J., and Cohen, J. (1988). Also see The Economist (2014) http://www.economist.com/blogs/americasview/2014/01/violence-venezuela

54. See https://www.unodc.org/documents/data-and-analysis/Crime-statistics/International_Statistics_on_Crime_and_Justice.pdf. See also examples at the national scale at http://www.governing.com/gov-data/safety-justice/police-officers-per-capita-rates-employment-for-city-departments.html for US data or http://www.statcan.gc.ca/pub/85-002-x/2014001/article/11914-eng.htm for Canadian data by city.

55. UNDP's Human Development Report for Latin America 2013-2014 for example demonstrated how perceptions of insecurity in the region thwarted economic growth http://www.undp.org/content/undp/en/home/librarypage/hdr/human-development-report-for-latin-america-2013-2014/ For more empirical studies on the impact of perceived insecurity see Romero, D. (2014). Also see Robert Muggah, "Four ways fragile cities can avoid becoming failed cities," Sin Miedos, February 2015. http://blogs.iadb.org/sinmiedos/2015/02/06/fragile-cities-can-avoid-becoming-failed-cities/ Also see Muggah R. (2014). For a larger discussion on this see Macaluso, A., and Briscoe, I. (2015) https://www.clingendael.nl/sites/default/files/Trapped-in-the-city-communities-insecurity-and-urban-life-in-fragile-states.pdf

56. See https://www.unodc.org/documents/data-and-analysis/statistics/Homicide/Homicides_in_most_populous_city.xls for data from 2000-2012 at the city scale. See also https://www.unodc.org/gsh/en/data.html.

57. The GDELT dataset captures billions of data points in real time of what it calls "physical violence" – including riots, social unrest, political violence, and terrorist incidents. It tracks thousands of media outlets in over 100 languages.

58. Gallup collects data on the extent to which people feel safe walking in their city at night as well as victimization in its World Polls.

59. The 100 cities with the greatest exposure to natural disasters are located in the Philippines (21), China (16), Japan (11), and Bangladesh (8). See https://maplecroft.com/portfolio/new-analysis/2015/03/04/56-100-cities-most-exposed-natural-hazards-found-key-economies-philippines-japan-china-bangladesh-verisk-maplecroft/

60. See http://www.worldbank.org/en/news/feature/2013/08/19/coastal-cities-at-highest-risk-floods.

61. The UNU's World Risk Index is a composite variable that incorporates four components (exposure, susceptibility, coping capacities, and adaptive capacities) to provide an informed sense of the exposure and vulnerability of countries to natural hazards. See http://i.unu.edu/media/ehs.unu.edu/news/4070/11895.pdf. In addition, private insurance companies also produce data on the risk of cities to natural hazards. A possible source would be Swiss Re's CatNet http://www.swissre.com/clients/client_tools/about_catnet.html. The International Disaster Database is maintained by the Centre for Research on the Epidemiology of Disasters (CRED)(www.emdat.be). While EM-DAT is based on country profiles – they do have geo-referenced data that could be utilized.

62. For some of the challenges associated with these endeavours see https://www.oecd.org/science/Final%20GRMI%20report.pdf.

63. For a more comprehensive review of resilience frameworks and of the framing of resilience for this project see Patel R.

(2016), "Defining the Resilient City," Centre for Policy Research, United Nations University.

64. For example see Care's Pathways to "More Secure and Resilient Livelihoods" http://www.carepathwaystoempowerment.org/theory-of-change/

65. See http://www.preventionweb.net/english/professional/publications/v.php?id=37916

66. For example see Lloyd's City Risk Index - http://www.lloyds.com/cityriskindex/locations

67. This is particularly true for resilience work related to trauma and violence. See for example Ungar M. "Resilience, trauma, context, and culture," Trauma Violence Abuse, 2013 Jul: 14(3) 255-66 (http://www.ncbi.nlm.nih.gov/pubmed/23645297)

68. Bene et al. 2016

69. A wider array of factors could be added by drawing from consensus/stakeholder analyses of specific fragile contexts.

70. Sturgess, P. (2016).

71. This was made clear in UNU's assessment of 35 risk and resilience frameworks. Also see Patel (2016).

72. See Sherrieb and Norris (2010).

73. See Hough. M. et al (2010)

74. See http://www.interpeace.org/wp-content/uploads/2015/10/2015_10_14_FAR_Global_Workshop_Report.pdf at Page 6.

75. See World Bank (2008). Also see Gallup World Poll and individual polls on well-being in cities. The Gallup poll focuses largely on cities in the United States, however, could apply a similar methodology to assess well-being in cities across the world. See: http://www.gallup.com/poll/145913/city-wellbeing-tracking.aspx and for crime and trust in police see http://www.gallup.com/poll/14938/crime-city.aspx

76. See Varoli (2010).

77. See Hallegatte, S. (2014)

78. See for example, https://www.metlife.com/assets/cao/foundation/city-financial-inclusion-efforts.pdf . The IMF has experimented with the idea of developing an index that assesses the financial inclusion of countries around the world. Methods can be adapted to global cities. See for example, Goran Amidzic, Alexander Massara and Andre Mialou (2014) "Assessing Countries' Financial Inclusion Standing – A New Composite Index," IMF Working Paper WP14/36, International Monetary Fund https://www.imf.org/external/pubs/ft/wp/2014/wp1436.pdf. More specific metrics could include percentage access to a savings account, percentage that could use a bank or microfinance institutions for a loan, or even the ability to come up with a specific amount of money if needed in an emergency – all available through the World Bank Findex dataset. While these remain country level at granularity, they are collected among a random sample including cities and could be interrogated for a rough measure. Insurance penetration in many cities is also likely available from major insurers or the market leader in each city or re-insurers such as Munich Re or Swiss Re.

79. See Khan (2014)

80. See http://urbandata.unhabitat.org/explore-data/

81. Metrics could include electrical interruption frequency, electrical interruption length, water service interruptions, water loss (% of water loss) from the World Council on City Data and paved roads/streets (% of total roads/streets) from UN Habitat. There are also rankings provided by private entities such as Mercer's Quality of Living Survey that assesses living conditions in over 230 cities around the world. However, this survey is more geared towards multinational corporations and their expatriates and as such not necessarily a good indicator of resilience on the ground. See https://www.imercer.com/content/mobility/quality-of-living-city-rankings.html

82. See Winderl (2014), "Disaster Resilience Metrics" United Nations Development Programme. http://www.preventionweb.net/files/37916_disasterresiliencemeasurementsundpt.pdf and Simpson, D.M. (2006), "Indicator Issues and Proposed Framework for a Disaster Preparedness Index" http://beta.fritzinstitute.org/PDFs/WhitePaper/DaveSimpson%20IndicatorsRepor.pdf

83. See Cutter, S.L. et al (2010). "Disaster Resilience Indicators for Benchmarking Baseline Conditions." Journal of Homeland Security and Emergency Management, Vol. 7, No. 1 https://www.degruyter.com/abstract/j/jhsem.2010.7.1/jhsem.2010.7.1.1732/jhsem.2010.7.1.1732.xml

84. See Colletta and Cullen (2014).

85. See World Bank (2008)

86. See McCandless E., Simpson G. and Meroney Z. (2015)

87. One of the authors (Patel) also has a forthcoming paper statistically weighting the value of social cohesion to community disaster resilience compared with other demographic variables. See also Ahmed, R., Seedat, M., Van Niekerk, A., & Bulbulia, S. (2004).

88. Proposed proxies include blood donations, the inverse of property crime and violence, or direct measures of income and social equality as outcomes of good social cohesion. See Laiglesia, Juan. (2011) for proposed framework by

OECD, see Nannicini (2013) for blood donations and Sherrieb and Norris (2010) for the inverse of property crime rates. Numerous discussions cite the use of income and social equality measures as outcomes of good social cohesion, particularly the aspects of social inclusion and mobility that make-up social cohesion.

89. See Shoeller-Diaz et al (2012).

90. Sampson (1997) (2004), (2009), (2012) also see Valdez A., Kaplan, C.D. and Curtis, R.L. Jr (2007)

91. See for instance Blattman, C., Jamison, J.C., and Shridan, M., (2016), See: http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2594868. This study demonstrated how cognitive behavioral therapy that taught criminally-engaged men in Liberia how to be more patient, self-regulating and develop non-criminal social networks and identities had a lasting effect in reducing crime and violence, particularly when combined with cash. This is still emerging evidence but potentially meaningful. The study also demonstrates how this finding is backed by a body of work in the U.S. demonstrated how adolescent and adult based cognitive behavioral therapy programs are effective in reducing criminal recidivism.

92. See Zaheera Jinnah (2010) and African Centre for Migration and Society (2009)

93. See Buonanno (2009) and Sherrieb and Norris (2010).

94. See Andrews (2009).

95. See Barrios (2014).

96. See Freitag (2006).

97. See for instance https://www.fcm.ca/Documents/reports/Municipal_Emergency_Preparedness_and_Management_Costs_EN.pdf

98. Major assessments of city fragility and resilience have adopted mixed methods approaches. Indeed, Ronak Patel co-coordinated several studies including with MIT, the Graduate Institute (http://graduateinstitute.ch/home/research/centresandprogrammes/ccdp/ccdp-research/clusters-and-projects-1/security-sector-governance-and-t/urban-resilience-in-situations-o.html), and IDRC (www.hasow.org) and others. See also the work of LSE at http://www.lse.ac.uk/internationalDevelopment/research/crisisStates/Research/cafs.aspx.

99. For a good illustration of how difficult collecting data on cities is see David Simon et al (2015). "Developing and testing the Urban Sustainable Development Goal's targets and indicators – a five city study," Environment & Urbanization http://eau.sagepub.com/content/early/2015/12/17/0956247815619865.full.pdf

100. This is an imperfect approach and was used highly selectively. Consult the methods section of fragilecities.igarape.org.br for a detailed breakdown of the data availability and coverage.

101. The distribution of ranked cities is determined using natural breaks (Jenks) – a clustering method that arranges values into different categories in a way that reduces variance within classes while maximizing variance between classes.

102. See Muggah R. (September 2016), "Where are the world's most fragile cities?" Thomson Reuters Trust http://news.trust.org/item/20160912112924-6sk7n

103. See Muggah R. (2012) "Researching the Urban Dilemma" http://www.idrc.ca/EN/PublishingImages/Researching-the-Urban-Dilemma-Baseline-study.pdf also see Bosetti, L., Cooper H., de Boer J., and Munshey M. (April 2016), "Peacekeeping in Cities: Is the UN Prepared?" United Nations University Centre for Policy Research https://cpr.unu.edu/peacekeeping-in-cities-is-the-un-prepared.html

104. de Boer, J., Muggah R. (September 2015), "The sustainable development fight will be won or lost in our cities," World Economic Forum, Agenda https://www.weforum.org/agenda/2015/09/the-fight-for-sustainable-development-will-be-won-or-lost-in-our-cities/ Also see successive reports from The New Climate Economy available here: http://newclimateeconomy.report/

105. de Boer J., (March 2015), "The Fragile City: The Epicentre of Extreme Vulnerability," United Nations University Centre for Policy Research http://cpr.unu.edu/the-fragile-city-the-epicentre-of-extreme-vulnerability-2.html

106. de Boer J., (October 2015), "Time to take the challenge of rapid urbanization in fragile contexts seriously," Knowledge Platform Security and Rule of Law, http://www.kpsrl.org/browse/browse-item/t/time-to-take-the-challenge-of-rapid-urbanization-in-fragile-contexts-seriously

107. See for instance Verma, T., Araujo, N.A.M., and Herrmann, H.J. (2014). "Revealing the structure of the world airline network," Scientific Reports 4 no. 5638 http://www.nature.com/articles/srep05638