TREMORS & AFTERSHOCKS:

INTERPRETING PATTERNS IN URBAN STABILITY THROUGH THE GENETICS FRAMEWORK

Capstone Project Report
Columbia University School of International and Public Affairs

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Abstract

Accompanying the rapid urbanization of human populations across the globe, highly complex megacities are emerging as one of the 21st century's greatest challenges. To grapple with the immense complexity inherent to dynamic metropolises, useful frameworks have emerged to better evaluate and understand the vulnerabilities of urban stability. In particular, the GENETICS/ACE model, developed by students at Columbia University's School of International and Public Affairs in 2020, provided a framework with which to understand urban stability.

This project, in cooperation with West Point's Department of Geography and Environmental Engineering, seeks to adapt the existing GENETICS/ACE framework, which focuses on categories of Governance, Economics, Natural Environment, Energy, Technology, Infrastructure, Culture, and Security, into a quantitative model that can explain stability "tipping points".

Through the development of our model, we are able to break down some of the complexity in cities into an understandable system. This is done by providing a framework, or sub-model, through which to study changes in stability within each of the GENETICS variables.

In taking steps to operationalize the GENETICS/ACE framework, we aim to develop the capacity to identify trends or patterns in urban stability, as well as pinpoint the triggers or factors that are contributing to the permanence or shift in the current state of the city.

Acknowledgements

During these unprecedented times, we have been fortunate enough to have been surrounded by a support system of crucial groups and individuals without whom the completion of this project would have been impossible to achieve.

We would like to extend our gratitude to Columbia University's School of International and Public Affairs, and the United States Military Academy West Point's Department of Geography and Environmental Engineering (GENE), for creating an exciting project for us to delve into. In addition, we are grateful to last year's team composed by Sam Anderson, Larson Holt, Alex Pytlar, Wilailuk Poolee, Jonathan Salna, Bryan Terrazas, Yifei Wang and Tiny Zhang, who developed the GENETICS/ACE framework, from which we were able to springboard into this project. We definitely had big shoes to fill.

We would also like to thank our project advisor, COL(R) Patrick J. Mahaney, Jr., for his unrelenting leadership, timely advice, infinite patience and positive encouragement throughout the project, as well as the GENE faculty who supported us throughout this project. In particular Dr. Amy Richmond and Dr. Richard Wolfel for their insights, participation and collaboration at various stages of the project along the way, as well as a special thanks to Alex Pytlar for all his support, insights and help along the way.

Finally, we would also like to thank our friends and families for supporting us through this process, especially as we each coped with a fully virtual and environment and the challenges that have been brought by the coronavirus pandemic.

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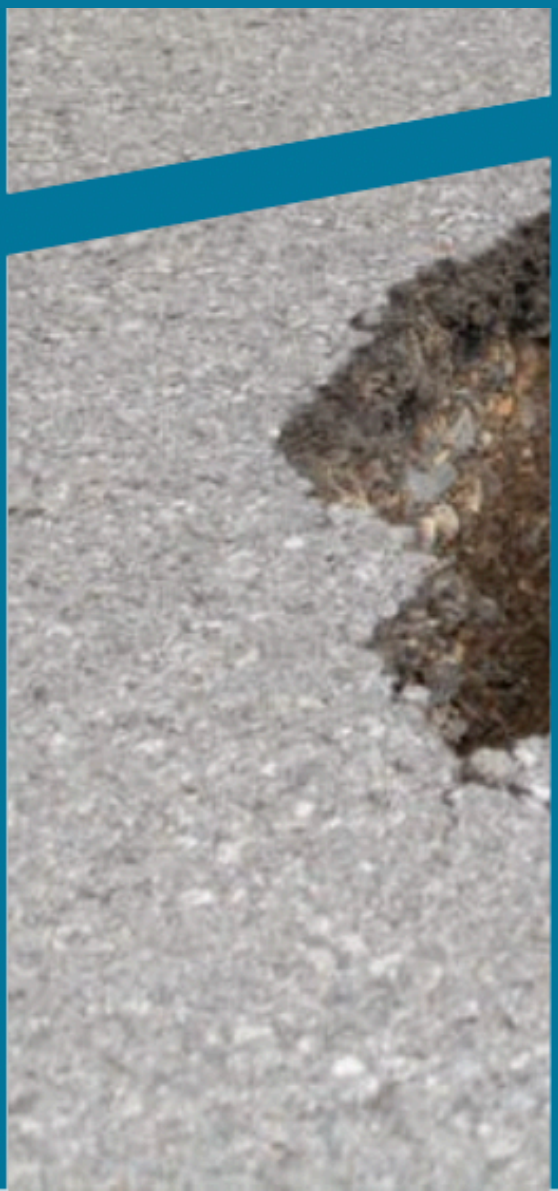


Chapter 1

LITERATURE REVIEW

Urban conflict, often avoided by military strategists as overly complex, has unfortunately become commonplace in the 21st Century. The globe is littered with previously stable metropolitan areas that, upon encountering various tipping points, devolve into chaos and require stabilization. The catalysts for these massive changes in urban stability are often unforeseen and difficult to predict. History is replete with dramatic episodes of urban stability tipping points, for example the rapid collapse of classical Maya society. In their case, a sudden change in rainfall patterns combined with economic and social factors to bring about a complete disintegration of their civilization. In our age of modernization and information technology, numerous factors interact to explain urban stability: governance, economics, natural environment, energy, technology, infrastructure, culture, and security. Dramatic changes in any of these single variables, or more than one, can mark urban tipping points, precipitating conflict and instability (Kitchin, and Dodge 57). The GENETICS and ACE framework developed by the 2020 SIPA capstone team built a framework for understanding the stability of urban environments. This project, in turn, seeks to transform the GENETICS/ACE framework into a quantitative model, one that can analyze, track, and evaluate a given urban environment's stability.

THE FUTURE OF URBAN AREAS

Myriad academic studies have alluded to competition for limited resources as the principal cause of urban conflict in high population areas (Moser and McIlwaine 331). As the number of people in urban areas increases, violence, poverty, and inequality become major headwinds for urban stability. This concerning trend in the world's major cities requires careful consideration. Kitchin and Dodge opt for an urban infrastructure network that can utilize computation as a way of solving the

escalating urban problems (1). On the security front, countries around the world have embraced the concept of smart cities as a means of transforming "urban governance, management and living through the use of new networked technologies" (1). Smart cities provide many solutions to the problems facing urban areas. For instance, Colonel Harris et al. argue that as the rate of rural to urban migration accelerates, over 60% of the world's population will soon be living in cities (4). This comes with risks such as unregulated growth, demand for humanitarian relief, climate change, and increased poverty. An increase in the gap between the rich and poor, measured in a variety of ways (including GINI coefficients), may even lead to violence. Furthermore, failures to integrate newcomers and underprivileged individuals into the urban economy can exacerbate resentment and undermine stability.

OPPORTUNITIES AND CHALLENGES OF MEGACITIES THE FUTURE

There is no better way to explain the threats and possibilities for megacities than drawing upon Malcolm Gladwell's concept of "tipping points." Indeed, overlooked explanations or seemingly minor changes in Government, Economy, etc. can make a massive difference in observed urban phenomenon. Gladwell, in addition to Walby, Schelling, and other eminent scholars, used the concept of tipping points to describe any rapid change in livelihood, within a short period of time. According to Gladwell, "The notion of the tipping point comes from epidemiology, and refers to the moment a given social process becomes generalized rather than specific in a rapid rather than gradual manner" (12). The transformation of New York City into a preeminent global city is a perfect example of positive tipping points, where the city grew by leaps and bounds. Accordingly, scholars believe that sustainability in urban areas can be solved through the creation of megacities through a generalized and rapid manner. Glen et al., defines a megacity as, "an urban area of extraordinary population size, geographic spread, physical and social complexity, interconnectedness, and similarly exceptional characteristics, to include influence with at least broader regional scope" (11). Building out megacities as an engine of human development critical for the future. As Harris et al. posit, "to ignore megacities is to ignore the future" (4).

On the flip side of the coin, research also indicates that "megacities will be the strategic key terrain in any future crisis that requires US military intervention" (Harris et al. 5). As the

population in urban centers increases, to even higher levels than we observe today, fragility and lack of stability become major issues for policymakers across the world. Evidenced by the attacks on September 11, 2001, urban centers easily become targets for terrorist groups and nefarious actors seeking to push political agendas with violence. Beyond terrorism, criminal gangs develop black-market urban economies to supply drugs and traffic human beings. Consequently, military planners and policymakers must ensure that security, as a condition necessary for stability, is not compromised. Adding to the Army's understanding of megacities in future, a research team from the US concluded that the Army has a critical role to play in the existence of megacities. This newfound responsibility for megacities across the world poses a threat to the US capabilities and interests. Moreover, the Army will need new strategies, tactical approaches, as well as operational approaches in these vast urban environments to succeed. As the development of megacities is on the rise, the Army should shape itself accordingly to be able to deal with the complex environment with the megacities. As Harris et al. suggests, the process should begin as early as possible to avoid blind spots from which strategic surprise could emerge (21).

STRATEGIC APPROACH TO URBAN AREAS PROBLEMS

The complex nature of urban areas, calls for unique problem-solving strategies and mechanical systems. The Army doctrine on urban terrain fails to account for the complexity of urban areas, particularly megacities. As the United Nations (UN) suggests, a megacity "must be understood as more than the sum of its parts." This means that the Army's approach of simply recognizing urban areas as "complex environments" and evaluating urban components individually is inadequate. Harris et al suggest understanding of the characteristics of megacities as a move to formation of an effective operational environment (10). These characteristics include density, scale, interconnectedness, threat profile, context, and flow. In the article "How we shape our cities, and then they shape us," Sevtsuk argues that a city should be designed in a way that is adaptable to future geographic constraints, real-estate markets, climate conditions, and the reliability of utilities and services (8). This adaptability he notes, creates a bridge that allows the relationship between the people and the environment to mature.

Given that the Army doctrine concept of "complex environments" is an insufficiently robust approach to the future of urban problems, Haris et al.

suggest that the Army should understand the interplay between the various characteristics of megacities and combine them with the "drivers of instability and capacity" (11). This will reveal a typology that the Army can use to classify cities in various categories of stability. Additionally, such a framework can also inform operations in those cities, if and when conflict arises. The dynamic of instability and capacity are fundamental in explaining the tipping points of various cities. Some of these include; population growth and migration, hostile actors, gentrification and separation, resource competition and environmental vulnerability, antifragility, capacity, resilience, among others.

While population is increasing dramatically in many megacities across the world, most of them are not well prepared to accommodate the people (Sevtsuk 13). Furthermore, cities are struggling with ethnic, racial, and subcultural separation, as well as income disparities. When these divisions build over time, they may erupt causing violence and instability (Boyden et al.). Environmental vulnerability has been identified by many scholars as a major contributor to separation and marginalization. Environmental disasters result in competition, resource disparities, and eventually instability. In analyzing the March 11, 2011 earthquake in Japan, Glenn explores the devastating impact the disaster had on Tokyo's populace (20). Oftentimes these disasters lead to the widening of the gap between rich and poor, contributing to instability. Moreover, sustainability and resilience are crucial factors for consideration when determining the surge capacity of a city (Moser and McIlwaine 340). Ignoring these factors has been associated with inability to adapt to volatility and stress in most cities. Nassim proposes that cities should learn to grow from adversity through the process of antifragility (24). Cities with highly integrated systems often exhibit high levels of antifragility (Harris et al. 13). For example, the ability to learn from setbacks and design new systems to prevent future occurrences of similar events positions New York City as antifragile. There are many cities that respond poorly to adversity. Cities like Dhaka in Bangladesh and Lagos in Nigeria operate under a loosely integrated system and therefore are more vulnerable to negative shocks.

Lagos, Nigeria exhibits poor and weak hierarchical governance and security systems (Harris et al. 27). Consequently, the city is loosely integrated. The city's population of over 20 million people (Harris et al. 27), surpasses its capacity. Although there are urban planning efforts

in place to restructure the city, the probability of quickly fixing the deteriorating security systems, not to mention the rest of the infrastructure, seems impractical (Harris et al. 29). This exposes the city to possible infiltration by Boko Haram and other bad actors in the future (19). The typology of Lagos as a megacity is characterized by federal and local governance and security structures. However, its high population and limited resources makes enforcement of regulations problematic. Given that Nigeria's stability is vital for maintaining the security of West Africa, it is important military planners focus on it. The US military can help the city in its integration process due to its interest in Nigeria. Comparatively, New York City represents the epitome of a highly integrated city. As suggested by the Strategic Studies Group, the city is a "wellspring of modern American culture and home to some of the most recognizable structures in the world" (15). In terms of typology, the city is highly resilient due a plethora of resources it has, well organized hierarchical structures, and well-developed systems. The security systems, in particular, are highly integrated making the need for military operations unlikely.

URBAN METABOLISM

The biophysical model of quantifying urban materials and identifying energy flows within a city represents the foundation of modern urban metabolism. The idea in this case is to look at the flow of specific materials within an urban system, with the aim of making urban areas more self-sufficient. Urban metabolism is a key tool for identifying the types of environmental problems that exist and then coming up with urban policies that are in line with coming up with the best urban planning policies (Rapoport 5). The role of an urban political ecologist revolves around identifying connections that exist between the domain of nature and the domain of humankind and combining them in the context of urban areas. In this case, the military is required to play a significant role in the domain of humankind that requires the use of strength, violence, and intimidation in urban areas. Both energies and systems found in the urban areas allow for urban integration and metabolism to occur.

Elizabeth Rapoport suggests a slightly different strategic approach to solving urban areas problems. Through her study on urban metabolism, she identifies six themes within which effective urban planning is based. The first theme

analyzes urban areas as ecosystems. According to Rapoport, holders of this view argue that intervention measures or strategies for urban areas should focus on creating stable and resilient cities (6). The second theme is the idea of "studying urban material and energy flows" to inform people's understanding of the city. This perspective is based on the field of industrial ecology. Its proponents propose that people should focus on the economic and environmental performance of cities. Generally, it borrows from the spatial characteristics and social factors that create a viable city. The third theme focuses on the importance of social, technical and ecological interconnectedness of urban areas. It explores the biophysical and social processes that take place in cities. The fourth theme, intellectual antecedents, hinges on the way that urban areas produce and reproduce separation and inequality. Macro-level theorists, ecological economists, and recent studies of ecological conflicts have helped develop this theme. The sixth theme focuses on governance in urban areas. It discusses the ways in which neoliberal reforms and the politics of urban elites shapes urban metabolism.

According to Gandy, urban metabolism is a concept that was influenced by biophysical sciences and political economy. The political economy perspective is connected to Marx who came up with the concept of urban metabolism in trying to address the "contemporary problems of soil productivity and the shortage of agricultural fertilizers by creating an urban-rural metabolism" (Rapoport 7). The bio-physical facet was pioneered by Eugene Odum (8). Scholars have conducted further research in the same field to analyze the interaction between the environment and its users. Gunawan has pointed out, the aspect of urban metabolism may closely be related to elements of sustainability, with regards to a particular city (56). Sustainability categories can be closely linked to the concrete ways city councils and mayors are working towards addressing urban sustainable development (Gunawan 56).

The two facets provide dynamic ways of looking at urban metabolism. According to Boyle et al., urban management has for the whole of the second half of the 20th century been guided by the idea that the city is a system. Wolman conducted a study dubbed "The Metabolism of Cities" in which he "modelled the metabolism of a hypothetical US city of one million people." His study influenced further research into the distribution of human population in urban centers and the impact on development, resource

availability, environmental integrity, and energy availability (Boyden et al. 62; Hanya and Ambe; Cui; Ulgiati and Zucaro) Moreover, Restrepo and Morales-Pinzon emphasized the term urban metabolism as, "a concept in which the city is using the biological notion referring to the internal processes by which living organisms maintain a continuous exchange of matter and energy with their environment to enable operation, growth, and reproduction" (220). Various studies on urban systems have rotated around the economic and biophysical approaches. Yong et al. discusses the core characteristics of urban system environmental integrity as well as resources in order to develop a sustainable urban economy (154). Huang et al. on the other hand links urban metabolism to socioeconomic systems and the natural environments (180). The more dynamic the views are, the easier it becomes to understand urban metabolism as a natural ecosystem.

In cementing the findings that have been discovered in this forum, Jakarta, as a case study, closely relates to factors such as the rate of precipitation, the solar radiation, the greenhouse gas levels, the amount of solid waste, the consumption levels with regards to the use of electricity, the production of water, and its consumption. In a nutshell, the analysis of the urban metabolic framework of the city of Jakarta leads to additional findings such as the idea that the city of Jakarta is considerably less sustainable because of its dependency on the use of fossil fuel (Gunawan 58). Additionally, the city lacks sufficiency in regard to management of the waste release and the emissions that flow out, which brings about negative effects on the environment such as the lack of recycling facilities or rather the environmentally friendly treatment of solid waste that exists across the city. Gunawan adds that the enactment of targeted administrative policies can provide solutions to the inherent transport problems by using less privately arranged transport and embracing use of public transport (62).

SMART CITIES AND TECHNOLOGIES

The choice of whether or not to have smart cities is not a realistic choice. It is a requirement for global cities to meet the demands of our technological age. However, this has opened up cities to new urban weaknesses. In 2016, the San Diego government published a report that the city was being hit by about 60,000 cyber-attacks a day (Anand). The attacks focused on specific elements of the nation's infrastructure, specifically targeting systems related to the electricity supply, which saw about 10,000 attacks

against it in a single month. The cyber-attacks have also moved to the transport systems where there are real attacks as well as proof of concept probes. Not restricted to any specific sector, infiltration even threatens aspects of the city's telecommunications. The main worry being, most inter-governmental attacks are launched against military infrastructure. In some instances, the armies of foreign adversaries have taken it upon themselves to equip special units with hacking capabilities, meant to disrupt the normal flow of information or energy across American society.

The solutions to such urban problems focus on smart cities use of well-known technical solutions to the issues such as the use of access controls. This is by setting in place steps such as two-factor authentication systems or password systems using biometrics that makes it difficult to access systems without having the required set of biometrics (Kitchin 13). The other tools include malware checkers, firewalls that are properly maintained, and specific types of procedures that enhance routine patching of software and the quick ability to engage in a response using urgent updates to close up exploits as to when they occur. Such solutions have been reliant on various institutions including the military complex that is on the frontline in implementing the raft of solutions in protecting state secrets and systems against attacks by foreign nations. And if that occurs, the military is left with the responsibility to respond as it deems fit at that particular point in time.

DEFINITIONS

Adaptive- "Ability of cities to plan, prepare for, facilitate, and implement adaptation options, typically targeted towards unanticipated threats." Requires systematic decision-making processes and amicable interaction with and among citizens.

Coping Capacity- "ability of a city to avoid irreparable damage from which it is unable to recover" in the event of an event outside of the control of a government.

Expected Benchmark- Minimum threshold to maintain a standard of living. Different for each category.

Our definition of Stability is derived from the military definition for Stabilization in Joint Publication 3-07:

Stabilization is the process by which military and nonmilitary actors collectively apply various instruments of national power to address drivers of conflict, foster host-nation resiliencies, and create conditions that enable sustainable peace and security. (JP 3-07, 2016, p. ix.)

Stability - conditions that enable sustainable peace and security.

GENETICS OVERALL MODEL:

OPERATIONALIZING THE GENETICS/ACE FRAMEWORK

Chapter 2

GENETICS OVERALL MODEL

In 1978, British statistician George Box, discussing the burgeoning science of statistical modeling, coined the popular aphorism "all models are wrong but some are useful." The assignment of numerical values to complex social phenomena is extremely challenging and fraught with reduction. Despite these clear challenges, this project seeks to develop a basic model for urban stability that is both useful and, to the extent possible, minimizes necessary reduction. While analyst reports can consume volumes of text and be difficult to readily communicate to policymakers, numbers can efficiently encapsulate complex ideas about urban stability in a fraction of the time.

For those who are skeptical about the feasibility of such a herculean endeavor, similar products have emerged in the field of data science. Just in recent years, sentiment analysis has taken off as a way to numerically convey the "feeling" of the English language in text format. The emotional qualities of words are extremely subjective and highly dependent on context, yet data scientists have already gone through the process of assigning emotional "scores" to English words. This allows analysts to simply run a function on any text block to develop a quantitative score of its emotional content. On a macro level, this can communicate to social media companies, like Facebook and Twitter, how angry or happy its users are based on their posts. Tracked over time, and coupled with machine learning, these technology giants, most notably Facebook, have actually run experiments to influence the feelings of their users. Even if the number derived by the sentiment analysis is occasionally misleading, more often than not it correctly discerns the intent of the author. Consequently, it would fall under George Box's "useful" model category.

In developing a numerical model for urban stability, we have adapted the GENETICS/ACE theoretical framework to be a mathematical equation. The intent of the project is to communicate complex information to policymakers and military commanders in the field. In its early form, the model will be backward looking, attempting to explain observed changes in urban stability (i.e. Hong Kong case study). Long term, as the model is further developed, the collection of GENETICS/

ACE data could conceivably allow for the prediction of future shocks to urban stability. Savvy analysts, equipped with superb data and modeling skills, could study past tipping points and identify the warning signals that precede urban stability shocks, or "urban stability earthquakes".

The below equation outlines the impact of individual variables in the GENETICS base model:

$$Y(urban\ stability) = G + E + N + En + T + I + C + S$$

ACE in our model, it is worth noting, has not been fully integrated yet. As a placeholder, we speculate adaptive capacity, coping capacity, and expectancy benchmarks, are applied across the model as an exacerbating or dampening input for each independent variable. Higher ACE scores will dampen the impact of changes to GENETICS variables, while lower scores will amplify the shocks observed by analysts. Taken in isolation, the numbers put into the model (scale 0 to 100) are not particularly meaningful. In the first instance, they simply reflect the subjective comparisons between cities made by a given analyst. Naturally, the baseline Economic rating for New York City (closer to 100) will be higher than Mogadishu, Somalia (closer to 0). However, baseline values are *not* the most important unit of analysis for urban stability tipping points. What we hope to capture with our model is the *change* in

$$\Delta Y = \Delta G + \Delta E + \Delta N + \Delta En + \Delta T + \Delta I + \Delta C + \Delta S$$

stability as a consequence of a unit change in the GENETICS independent variables. Tipping points are defined to be the initial T^0 deterioration in stability that accelerates as the urban environment is forced, usually downward, to a lower stability level.

To avoid the complications of making measurements entirely quantitative, since we simply lack the resources to do so yet, the relevant *delta* for underlying variables can be described in terms of standard deviations from the hypothetical mean. Although this project does not seek to develop an advanced quantitative analysis of each variable, with the exception of a Sub-Model for Government, we intend to demonstrate how such a complex model could function.

For the purposes of illustrating the concept, we make two key simplifying assumptions: i) the mean *change* in GENETICS variables is zero, and ii) their change can be plotted on a normal distribution. A large negative move, determined by the analyst, will have an outsized negative impact on the stability of a given urban center than a comparatively small move. Furthermore, not all variables are equally relevant to each urban environment. Consequently, independent variables of high importance will be assigned heavier weights than others.

A powerful analogy for the above endeavor is the measurement of earthquakes in natural sciences. Although the earth's crust is constantly moving, most earthquakes are small, imperceptible to humans on the ground. The same is true for minor changes in our GENETICS variables. However, as you increase the severity of the earthquake, it becomes impossible to ignore. In 1935, Charles Richter set about developing a scale for classifying earthquakes, based on their strength. This science was empowered by

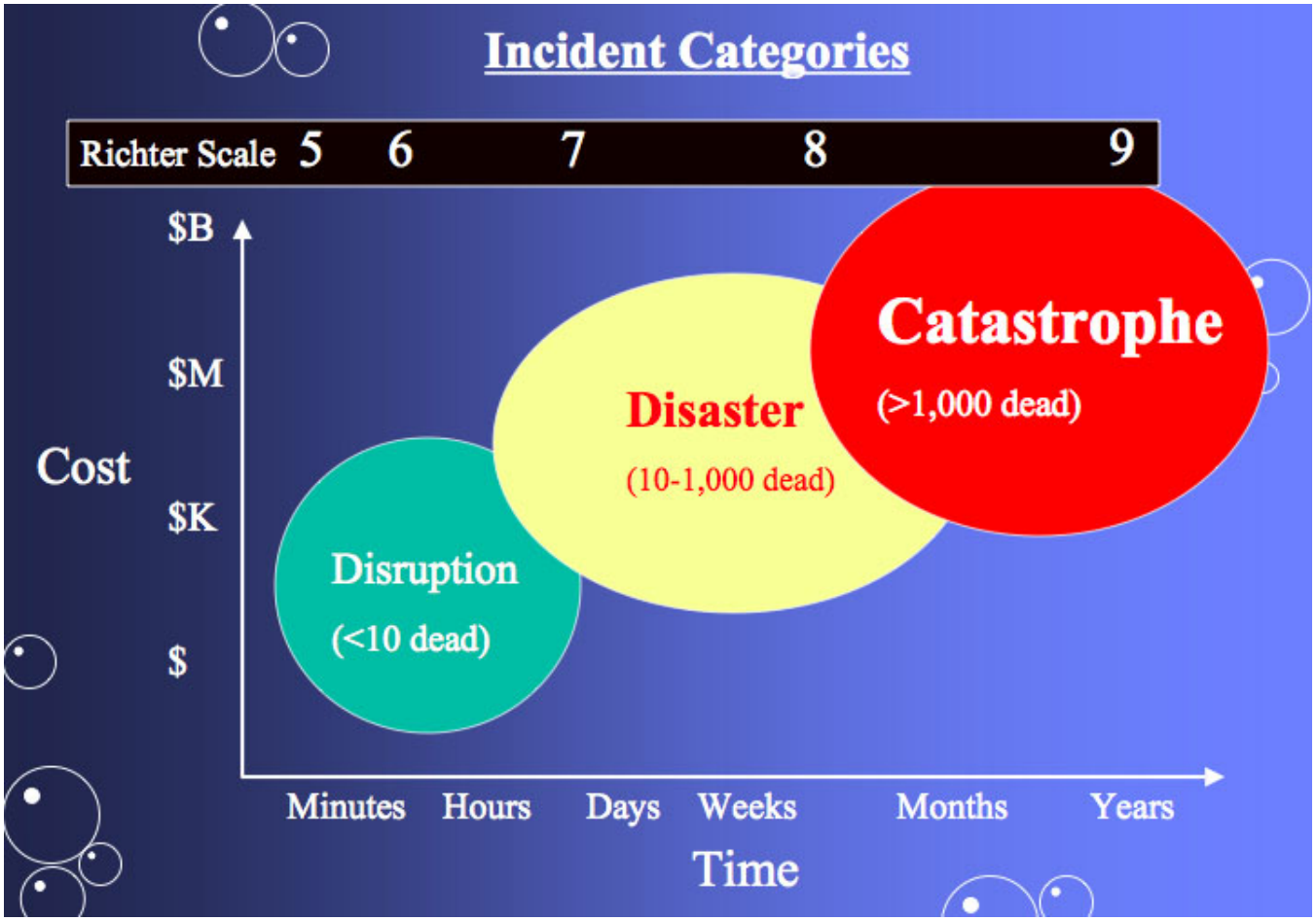
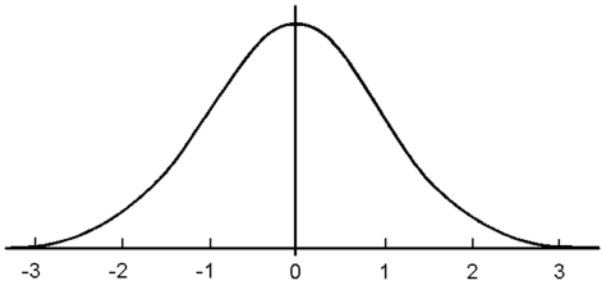


Figure 2.1 For Earthquakes, the Richter Scale's numerical values are associated with different levels of damage and cost. Since the scale is logarithmic, each single whole number increase is associated with a 10x greater measured amplitude. As data is collected via the GENETICS model, we believe such a scale could also be developed to communicate the severity of urban stability "tipping points."

new tools that could measure the severity of earthquakes and associate them with cost in $ (see below chart).

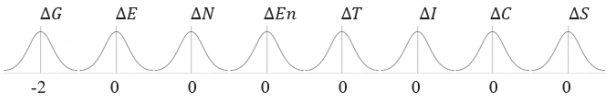
Prior to this project, no quantitative model exists to measure the changes in GENETICS variables with respect to urban stability. As data is accumulated using our urban stability model, it will eventually be possible to perform analyses of stability shocks to urban environments and categorize their severity. The development of a Richter Scale for the changes in GENETICS variables, measured as standard deviations from the mean, may also be possible. Examples of extreme shocks and minor shocks are already easily observable, but we lack the numerical data to support our analysis:

MINI CASE: 1929 GREAT DEPRESSION NEW YORK CITY- Δ ECONOMICS



Before developing a robust quantitative sub-model model for Economics, it can be inferred that the negative shock during the Great Depression in New York City (close to -3 standard deviations delta in economic score) would have a severe impact on the city's overall stability score. We can hypothesize the reason New York City did not simply dissolve into complete chaos at the time is because other stability factors, perhaps improvements in Government or high levels of adaptive capacity or expectancy benchmarks, ameliorate the shock.

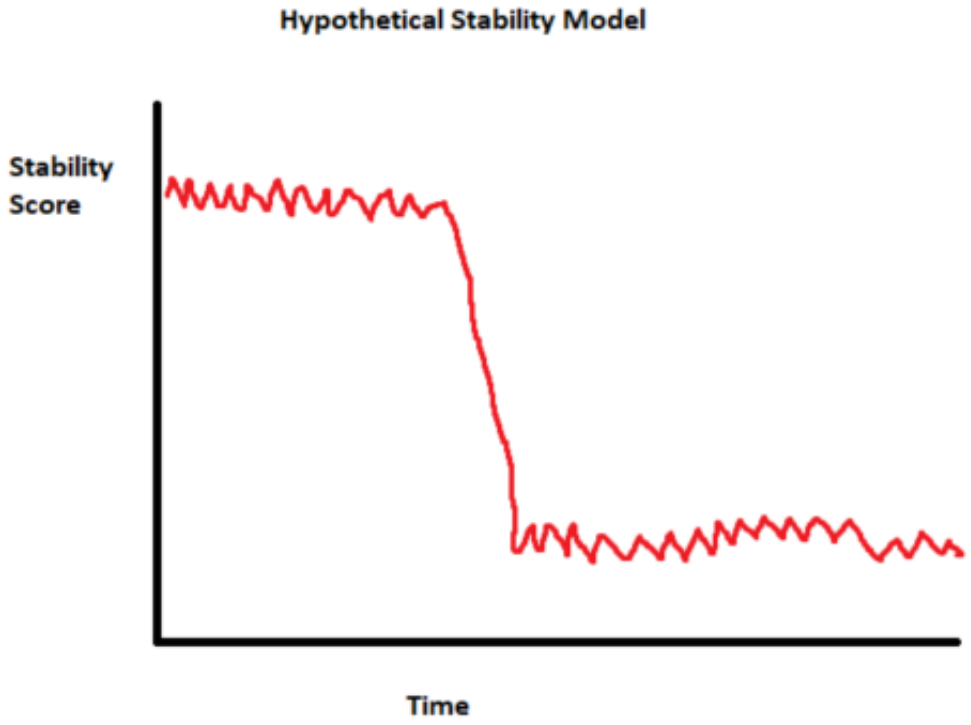
CASE STUDY HONG KONG PASSING OF NATIONAL SECURITY LAW (THEORETICAL):



During a very short period in 2014, there was a dramatic deterioration in the Government variable in Hong Kong. The determination of this change was outlined by our sub-model for Governance (in the below section). As a result of this significant "G" move, the overall stability score of the mega-city falls and is recorded as a tipping point.
Similar to the movement in the earth's crust, there is a natural variation to the stability of a given urban environment. These tremors are not of particular interest to the military high command, as they usually do not threaten peace and order. The "tipping point" occurs when stability is knocked off its range to a new equilibrium. A cause in the drop in

stability can occur because of a large delta in (one or all) G, E, N, En, T, I, C, and S. As this project begins to collect data, some tremors may approve predictive of future meaningful shocks. However, such assessment will require additional data and a completion of the below framework.

order for the model to make sense. Also, the impacts of ACE need to be more fully explored. Early in the process of modeling these cities, analysts could prove essential in determining bespoke weightings for different variables. For example, changes to Technology may be more impactful in a smart city (Singapore, Seoul, etc.) than a



WEIGHTINGS:

As we considered how our model would run in different cities, we quickly realized not all explanatory variables are necessarily equally important to every city based on geography. In order to explain certain observed changes in stability, the weightings might need to be adjusted in

less technologically developed location (Kathmandu, Ulaanbaatar, etc.). Consequently, before more robust weighting frameworks are developed, the model may be reliant on analysts selecting "significant" variables and assigning heavier weights in the model.

SUB-MODELING:

EMBRACING COMPLEXITY IN URBAN ENVIRONMENTS

Chapter 3

SUB-MODELING

In order to make an assessment regarding any aspect of an urban environment, in our case stability thresholds and tipping points, we must contend with the complex nature of a city. The sheer number of factors that interact with one another make this urban system extremely difficult to condense into any type of concrete variables to analyze. Yet, it is this complexity that requires a structured approach that can examine these complex interactions and factors. This cannot be done in a solely qualitative manner as the sheer volume of data and information go beyond anything that the human mind can comprehend at face value.

This paper sets out to develop a model that can help break down some of this complexity into an understandable system. We based our model on the GENETICS principles and have expanded on their interactions to develop a way in which to measure each variable in a way that allows us to assess the changes in stability as outlined above. However, we recognize that each of the elements in the GENETICS framework are in themselves a cosmos of variables and interactions that need to be incorporated into any value that will be plugged into the core model.

To do this, one must delve into the theory and scholarship behind each of the main GENETICS variables to identify key factors and interactions that can lead to a change in the stability scores. This research is interdisciplinary as the combination of subjects and fields allows us to paint a clearer picture. This section assesses the sub model for the G or Government variable of the main model. However, this same exercise must be conducted along each of these variables. We hope this project serves as a guide for future research into each of the GENETICS variables.

$$\Delta Y = \Delta G + \Delta E + \Delta N + \Delta En + \Delta T + \Delta I + \Delta C + \Delta S$$

LIMITATIONS

While this is an attempt to tackle some of the complexity that is innate to cities, it is important to highlight that this approach has its limitations. First, this model is in no way all inclusive. However it is a first step in boiling down some of the complexity associated with cities. Second, we do not presume to achieve objectivity. We recognize that any model, and potential future algorithm, that may take our research and apply large scale computing power to it, will suffer from bias. Bias will come from the variables we choose to include in the sub model. We knew it would be impossible to incorporate every single aspect that influences stability in cities in our model. As it is often said in political science, models that wish to explain everything end up explaining nothing at all. As such, in our efforts to create a level of parsimony in our model, our decisions to include variables were based on our research and leading academic literature in this field. Bias will also be present in the data collected. Both in terms of data availability for specific variables or for specific cities or time periods, but also from human biases that become reflected in the data and so on. Even a perfectly unbiased algorithm can be subject to bias based on the data inputs, and there is a whole field of research on whether an unbiased algorithm is even possible. A topic which should be explored further in any further research within this field of study. Finally, as stated above, this is far from a full model that can arrive at the stability scores we aim to compute. Rather we aim for this paper to serve as a framework that can eventually be allotted data science processes and computing power to arrive at conclusions.

THE TRIAD OF EXPERTS

Based on the interdisciplinary nature of our project, we envision a triad of experts in their own disciplines that can come together to enable this project. Social Scientists have produced the theory behind the multiple components that compose our GENETICS variables, as well as how we expect these to behave. The theories they have come up with help us determine how the behavior of specific variables will lead to greater or less instability. The second is the Data Scientists that will help us build the algorithms that will enable much of the data analysis that will power our model. Finally, we acknowledge that there is a wide range of diversity between cities based on history, context, geography and so on. Hence, the third element of the triad are the Regional Experts that have the ability to help us fine tune our analysis to specific regions or contexts as necessary.

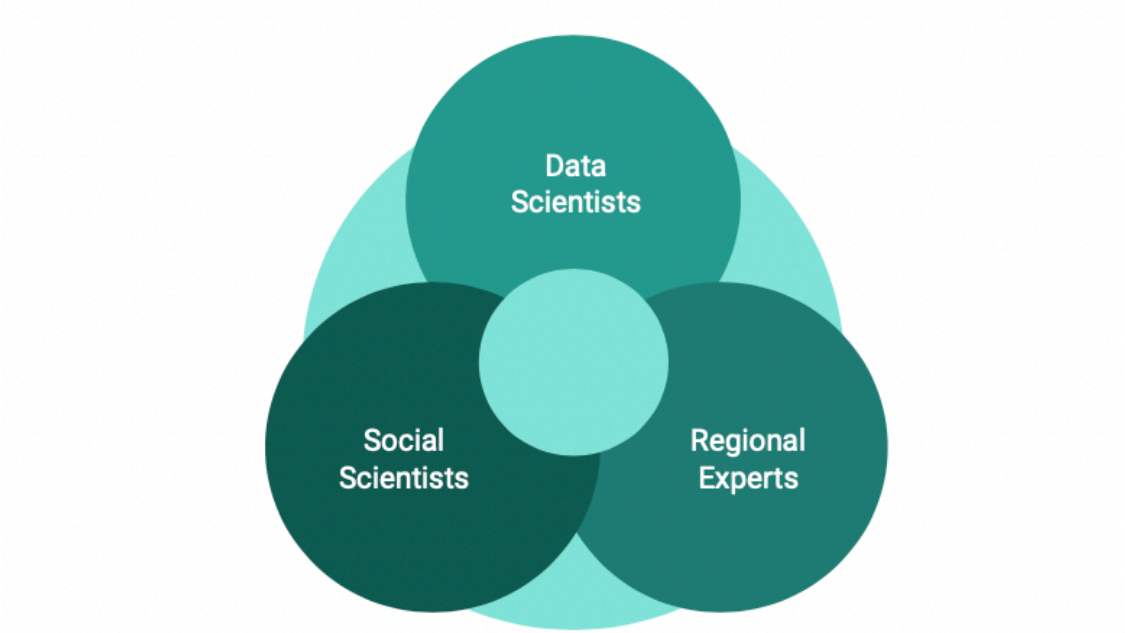
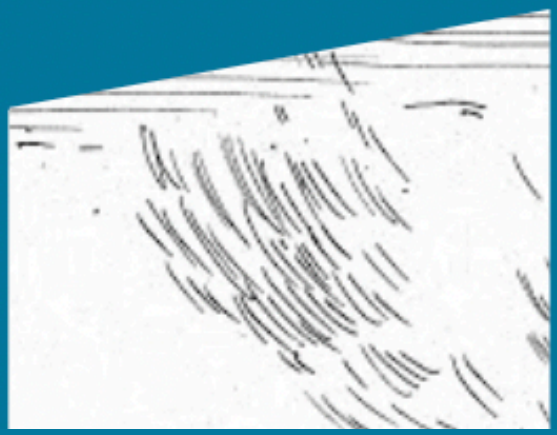


Figure 3.1 The Triad of Experts

G-SUM MODEL:

BREAKING DOWN GOVERNANCE INTO ITS SUBCOMPONENTS



Chapter 4

G-SUM MODEL

As with our general GENETICS model, we have translated the different theories that explain elements of stability within cities into a mathematical equation that identifies the delta change in our explanatory variable. Adopting the same approach, baseline values are not the key unit of analysis for urban stability tipping points. Rather, it is this change in stability, as a consequence of a unit change in the sub categories, that we care about in assessing stability in governance.

GOVERNANCE

Urban governance refers to the processes by which the government at the local, regional and national level, as well as other stakeholders, decide to organize, finance and manage urban areas. It is a process of constant negotiation and contestation over the allocation of political power and material resources (Avis, 2016). Urban governance is a particularly complex area of study due to the existence of multiple and competing forms of authority. This has important implications as the different structures in authority often clash over the imposition of what each believes to be their prerogatives (Moser and Rodgers, 2012). While city government is the most visible and perhaps largest government actor, there are many more actors that play an important role in city dynamics. These include the market and private businesses, agencies of the central state, the role of collective voluntary action by civil society just to name a few (Avis 2016). As such we must take a multifaceted approach when examining the elements that affect stability in cities. Based on our research we developed the G-Sum sub-model for governance based on five key variables that incorporate the role of different actors, stakeholders and interactions in the stability of cities.

Based on a preliminary literature review, we identified the sub-variables that compose five key variables illustrated above. By taking this approach, we are infusing our model with an added layer of complexity, that better reflects reality, and provides guardrails for analysts to identify data sources and make assessments on these element's impact on stability.

GOVERNANCE VARIABLES

CIVIL SOCIETY

- Social Movements
- Social Capital
- Level of Civic Engagement

POWER CONCENTRATION

- Elite Dynamics
- Elite Conflict
- Economic Inequality
- Location of Power
- Periphery
- Power of Special Interest Groups
- History of Gender Based Insecurity
- Political Inclusion
- Religious Presence in Politics

POLITICAL SYSTEM

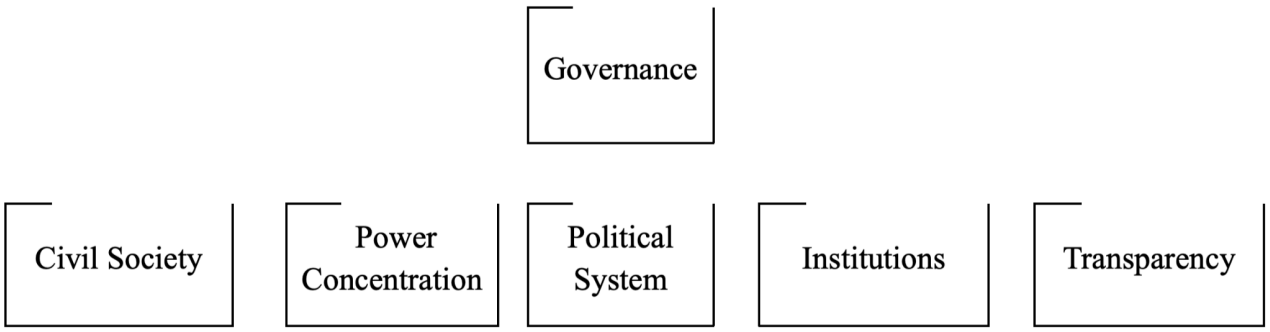
- Regime Type
- Democracy
- Voting System

POLITICAL INSTITUTIONS

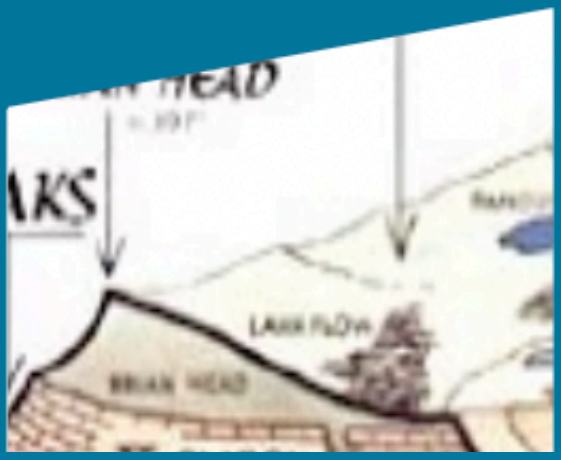
- Provision of Services
- Bureaucracy
- Constitutional Reform
- Judiciary

TRANSPARENCY

- Free media
- Established processes
- Corruption

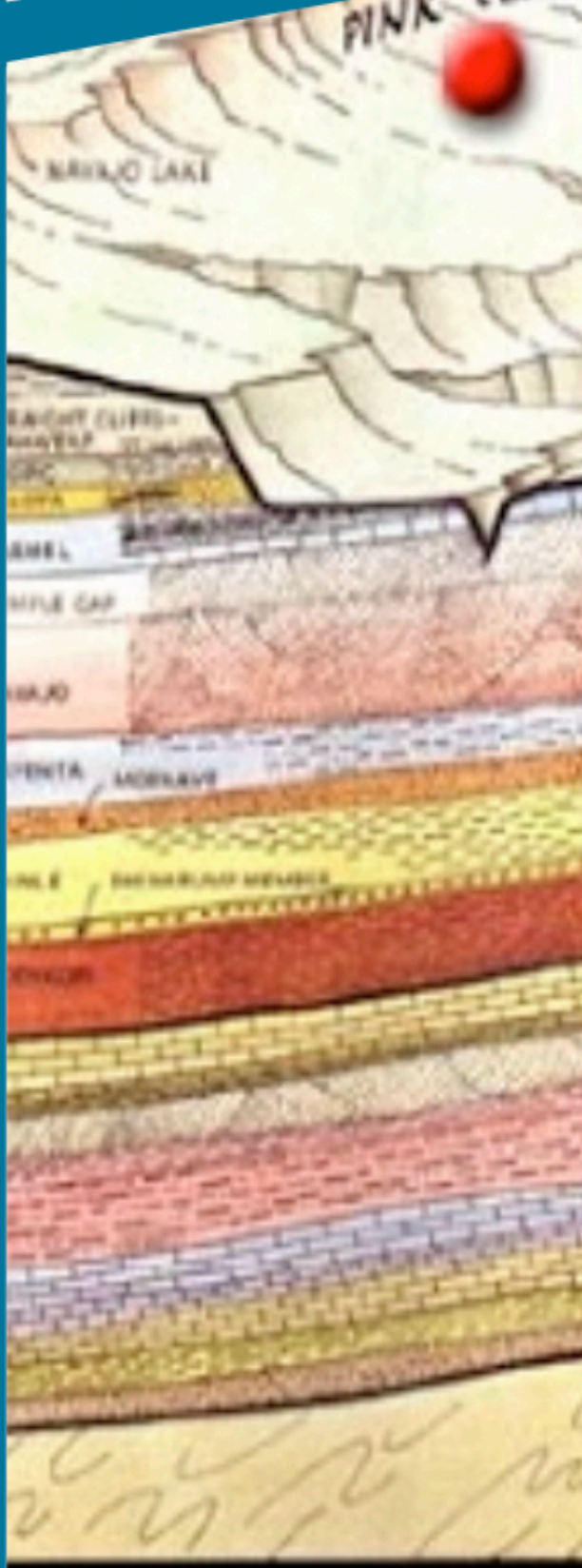


$$\Delta Y\,(Governance) = \Delta Civil\ Society + \Delta Power\ Concentration + \Delta Political\ System + \Delta Institutions + \Delta Transparency$$



DEEP DIVES:

ASSESSING THE COMPOSITION OF THE G-SUM VARIABLES



Chapter 5

DEEP DIVES

For each sub-variable the triad of experts will collect data to determine whether that element is positive, negative or neutral towards a tipping point for that city. These serve as guardrails to inform the data sources needed to determine the delta change for governance as a whole. By creating these indices we are infusing the model with part of the complexity that makes up cities. It is important to note that both at the sub-model and model level, we will encounter issues of multicollinearity due to our data sources and the complex interactions of our variables in the real world. While this is not something we will be able to address at this early stage of the project, once the sub-models for each of the GENETICS variables are developed, this will certainly be an element that will need to be addressed.

The following section will provide an initial deep dive into some of the critical elements that compose each of the sub-variables. It includes potential measurements for data and when identified, available data sets. For each of the sub-variables, we have also provided an initial multidisciplinary literature review from which to build the G-sum model. However, this is by no means all inclusive and should be tailored in tandem with the development of the sub-models for the rest of the GENETICS variables and once data collection begins.

EXAMPLE SUB-VARIABLE MEASUREMENT

Social Movements	Negative
Social Captial	Neutral
Level of Civil Engagement	Positive

CIVIL SOCIETY

SOCIAL MOVEMENT

Social movements are defined as an excluded collective seeking social change (Tarrow, 2011). They are usually composed of groups outside of institutional power that use unconventional strategies along with more conventional ones to achieve their aim. The catalyst for these movements is the real and perceived threat to their interests, through either institutional, economic, or political power as a primary motive. The initial condition for social mobilization centers on shared grievances. Once the collective action process moves from grievance formation to actual mobilization, social movements will likely formulate a set of demands. They will target institutions of power to present their demands too, this can be either elected or non-elected powers. A coalition movement develops when at least one other group is engaged to collective action.

MECHANICS OF INCREASED INSTABILITY FOR SOCIAL MOVEMENTS

Factor	Category
Type of Social Movement	1. Everyday form of resistance 2. Local grassroots movement 3. National social movement 4. Waves of protest 5. Revolution movement 6. Transnational social movement
Framing Strategy	1. Inclusive strategy brining multiple groups in as allies 2. Non-inclusive
Tactic Type	Novel or Disruptive
Size	Based on % of population
Media	Free and broad OR Oppressive
Involvement of key Type of participant	1. Student/Youth 2. Experts/ Professionals 3. Religious organization 4. Other Social Movement 5. Oppositional Political Party
State Actors	Sympathetic OR Non- sympathetic
Political Environmental Factors	1. Elite Conflict 2. Public opinion 3. Elite blunders 4. Countermovement

POTENTIAL DATA SOURCES FOR SOCIAL MOVEMENTS

There are many ways in which the Triad of experts can gather data to input into the model for this sub-variable, for example social scientists would conduct interviews and do observation to determine what type of social movement it is, for example everyday form of resistance or a revolutionary movement. The data scientist would use databases such as the Protest Event Analysis (PEA) to determine the size of the movement relative to the population, and the regional specialists would use their knowledge and contacts on the ground to determine whether the state actors are sympathetic or non-sympathetic.

SOCIAL CAPITAL

The network of relationships among people who live and work in a particular society, enabling that society to function effectively and live harmoniously. Social capital is historically hard to gather, however taking a broad look at the 'health' of a community will give the triad of experts a picture of the amount of social capital in a society. One of the unique characteristics of this sub-variable is its interconnectivity with the cultural and society element in GENETICS. Although social capital is located under government, this sub-variable highlights the interconnected nature of this model as many of the mechanics of increased instability will be the same as for some of the sub-variable under social and cultural.

MEASUREMENTS FOR SOCIAL CAPITAL

Factor	Categories
Family Unity	Share of births in past year to women who were unmarried Share of children living in single-parent families
Family Interaction	Number of divorces per capital
Social Support	Average number of close friends reported by adults
Community Health	Live births per 100,000 Life expectancy
Philanthropic Health	Amount of giving per individual Number of nonprofits in a society
Crime Rate	Rate of violent crimes per 100,000

LEVEL OF CIVIC ENGAGEMENT

Civic engagement is the level of participation in the work to make a difference in one's community. Unlike civil society which measures the overall health of a society, civic engagement focuses on the actions which improve society as a whole. When fed into the algorithm, the

civic society and civic engagement scores would be interconnected as they do overlap in many ways. For the civic engagement sub-model it is important to also factor in a measurement of gender and inequality gaps in civic engagement. This part of the algorithm could be broken down into different scores for gender, income level, and social-cultural background, to get an idea of if there is civil engagement across the board or if it is specific to one type of citizen. If there is only engagement by one type of citizen, this could be cause to turn this sub-variable red due to the underlying social unrest that would indicate.

CIVIC ENGAGEMENT SCALE

Factors	**Categories**
Religious Engagement	Attendance at religious services
Voter Turnout	Number of votes cast, as a share of the population registered to vote
Political Activism	Attending political events
Knowledge	Percentage of the population who keep up with current events
Civil Engagement Inequalities	Data Scientists should run the other factors by gender, income level, and social-cultural background to come up with an understanding of if there is civil engagement across the board or if it limited to one type of citizen

POLITICAL SYSTEM

REGIME TYPE

For a society to work satisfactorily, it requires a peaceful order and the availability of public goods. In anarchy, individuals may lose their belongings to violence and theft. As a result, in an anarchic system there are no incentives to produce any goods as they will likely be stolen. Thus there are important gains in providing the structure by which to create a peaceful order. While small groups ultimately organize themselves and create a form of voluntary collective action, at a broader scale large groups are unable to do the same, as there are many incentives for individuals to slack off and derive the benefits of others´ work. As such, government for groups larger than tribes arises through a rational-self interest amongst the individuals that have the capability to organize the greatest capacity for violence. In this way, those that hold the violence may dissuade others from acting against the collective interest. These violent entrepreneurs have taken different titles throughout history encompassing dynasties, monarchies, dictatorships and so on (Mancur, 1993).

The autocratic regime has an incentive to extract the greatest possible surplus from society and to use it for his own purposes. He will do this by using his monopoly on coercive power to obtain the maximum amount from taxes and other exactions. While some scholars may define these states as “predatory”, this metaphor fails to account for the fact that the autocrat possesses an interest in the territory and as such, provides domestic orders and public goods. However, the distinction between whether the regime provides stability will lie whether the autocrat can convince his subjects that their assets will be permanently protected. This is due to the fact that economic growth is generated by investment. If there is fear of expropriation, individuals will invest less, causing a chain reaction in which tax collections will decrease, in turn decreasing the provision of public services (Mancur, 1993). This downward spiral can ultimately lead to economic and social instability in society. It has often been explained that it is this desire for economic growth that has led to the establishment of democratic societies. To be able to maximize income society must be able to enforce contracts. As such it is this relationship between the monopoly on power held by the leaders, society and the pursuit of economic development, rather than the specific label given to a regime that must be assessed when determining the impact of regime type on our governance variable.

Factor	Category
Number of individuals wielding power	Is the power held by one individual, a group, or is it decentralized in multiple bodies.
Taxation and redistribution	Ratio: public goods provision as a proportion of tax collected
Protection of private property	Laws, incentives and other mechanisms that protect individual property

Based on these assessments one can then categorize regime time based on the more common taxonomy:

Factor	Category
Regime Type	Authoritarian, Competitive Authoritarian, Democracy

DEMOCRACY

Literature suggests that there are two competing types of democracy. Majoritarian or Westminster democracy refers to electoral and decision making processes based on a simple majority vote. Alternately, consensus democracy requires greater compromise and the incorporation of minority viewpoints and rights. Advocates for the later believe that consensus democracy is a better form of government, not only for societies with deep ethnic, linguistic, religious or ideological cleavages for which it is particularly effective at diminishing social unrest, but for societies in general. It has also been found that consensus democracies exhibit "kinder" or more "gentle" traits, such as lower incarceration rates, less use of the death penalty, better policies towards the environment, more foreign aid work and increased welfare spending (Lijphart, 2012).

Factor	Category
Consensus vs majoritarian	Ratio: number of political parties as proportion to those represented in the elected body.
Freedom House	Rating of people's access to political and civil liberties (measured at a country level, but similar methodology may be used if necessary to measure at city level)
EUI Democracy Index	Rating of world democracies is based on scores for 60 indicators each country is classified into full democracy, flawed democracy, hybrid regime or authoritarian regime. NOTE: This Index will incorporate various indicators for other components in our sub-variables. If utilized, this must be taken into account when building the sub-model to avoid multicollinearity in the data.

VOTING SYSTEM

The ways in which a government is elected vary significantly. These differences can be traced back to strategic decisions made by current ruling parties to maximize their representation. If the current electoral arena does not undergo substantial change, there are no incentives for the current ruling party to make substantial changes. However, when the electoral arena faces changes, because of the emergence of new voters with different political preferences, the ruling party may be more keen on making changes. This will depend on the emergence of new political parties and the coordinating capabilities of old ruling parties. When nascent parties are strong, the ruling party will shift from a plurality or majority rule to a system of proportional representation. On the other hand, if new entrants are weak the system will remain the same (Boix, 2000). This process will have important implications for city stability as the inability for minority views to be seriously entertained may lead to discontent and social instability.

Factor	Category
Voting System	First past the post, proportional representation, ranked voting, block voting, alternative voting etc.
Opposition Parties	Number of parties that constitute the opposition.
Coalition building	Ease or frequency of coalition governments.
Shifts in voting procedures	Frequency of changes to electoral processes
Trust	Public Trust in Electoral Institutions.

POLITICAL CONCENTRATION

The way urban violence is linked to politics is less associated with exclusion, but more frequently related to the urban elite obtaining or maintaining power. In cases where the state system was captured by this elite, or where internecine conflict occurred between different factions of the elite, urban violence in fact more often related to political inclusion than exclusion, that is to say to inclusion into a violent state system. All the case studies highlighted this in different ways: in Nairobi and Dili, youth groups were recruited by the urban elite to be instrumentally involved in political violence, while in Patna and Santiago this related to adverse integration into a segregated urban spatial regime, whether related to the violence associated with the spatial containment of slum dwellers in Patna, or the broader structural violence associated with the historical construction of Santiago as a neo-liberal city.

ELITE DYNAMICS

When a society has an overproduction of elite, there becomes conflict within that group which spills over into the general population. A society gets too many elites when income of commoners have stagnated and all income goes to the top earners.

Factor	Category
Number of Wealthy Individuals	About of people earning in the top 1% of a population relative to 10 years previous
Competitiveness at upper level parts of society	Number of contenders for political office in relation to race ten years previous
Nepotism	Percentage of those in prestigious careers related to others in those careers
Increased credentialing	Amount of credentialing needed to enter top earners of a society

LOCATION OF CONCENTRATIONS OF POWER

If all citizens who hold power are located in the same physical locations within a society, it decreases the ability of those not physically present in those spaces from accessing power. The long term effects of this sub-bucket combined with out sub-buckets could lead to a loss in power concentration for much of the population. Additionally there is the question of access to the physical spaces of power, new technology, such as teleconferencing, can allow more access spaces. A measurement of location of concentration of power should take into account both people and spaces.

Factor	Categories
Urban/Rural Divide	Share of top earners living in Urban centers verse rural locations
Disenfranchisement	Amount of gerrymandering in a society
	Voter turn out rates by location or district
Economics	Locationton of high earning jobs location of new jobs
Access to physical locations of power	Ability of public to access goverment offices amount of public transportation linked to government offices Hours of operations of government offices
Physical location of goverment	Amount of government offices located far away from the majority of the population's home addresses
Technology	Use of remote technology by holders of power which allow the work to be done in many locations

ECONOMIC INEQUALITY

There is a large amount of literature on how to measure economic inequality and this sub-variable only explores a small fraction of it. One avenue of future research would be to explore further this sub-variable and how to calculate the mechanics of increased instabilities that are effected by it.

Factor	Category
Income Total	Share of total annual income by income bracket groups
By Household	Household share of total expenditures
Distribution of Wealth	Gini Coefficient

POWER OF SPECIAL INTEREST/LOBBYING GROUPS

Special interest groups have a powerful role in any society, they are groups with the ability to advocate for a special part of society to the larger political institution. However the power of spacial interest groups must be weighed against the benefits to the society in large, if they are given too much power it could lead to lack of access for more marginalized groups. However, if they are given too little access, then the parts of society they represent will have no access to power. Measuring the power of special interest groups and lobbyist has always been a challenge for political scientists, but combining the triad of exports it is possible to come up with an indication of their power.

Factor	Categories
Funding	Percentage of Special interest or lobby groups funded by the top 1% of earners in a soceity
Legislation	Percentage of bill a group lobbies for which make it onto the congressional floor
Population	Percentage of population that belongs to an interest group

Factor	Category
Length of insecurity	Length of time period of gender or cultural insecurity
Persecution	Formal or information persecution based on gender or culture
Current power of historically insecure groups	Percentage of government officials from either gender, cultural, or racial backgrounds of historically discriminated groups

HISTORY OF GENDER, RACE, OR CULTURAL BASED INSECURITY

Every society has a uniquely different history with gender, race, or cultural based insecurities. Almost every society in history has discriminated against one or more type of its citizens based on those characteristics and many of the internal conflicts in the society will have an undertone of those past discriminations. How a government is dealing with its history of discrimination, and how the groups themselves view the steps it is taking, will determine whether a society is could erupt into conflict over gender, racial, or cultural based insecurities.

RELIGIOUS PRESENCE

Religion plays an important role in the concentration of power, whether through formal or informal channels. In some societies, the dominate religion might either fully run the government or have massive amounts of formal control. In other countries, the influence of religious leaders may be informal but still powerful. When taken into account both the popularity of the dominate religion and the acceptance of non-dominate religions in a society, the regional expert is able to come up with a score for how likely the role of religion in government would tip a society into conflict.

Factors	Category
Religious population	Percentage of population tied to a dominate religion
Importance of religion	Percentage of office holders and other power players in a society that belong to the dominate religion
Religious leaders	Whether or not religious leaders hold a formal position in government Whether or not religious leaders hold an informal role in government Whether or not the figure head of a government is required to be a dominate religion
Religious laws	Whether or not a society has laws tied to a dominate or non-dominate religion Rote of religion in the constitution
Popularity of Dominate Religion	Survey results of the popularity of the dominate religion
Acceptance of non-dominate religion	Percentage of the population that is a non-dominate religion Percentage of government officals who are of a non-dominate religion

POLITICAL INSTITUTIONS

PROVISION OF SERVICES

One of the core functions of urban governments is the provision of sufficient, affordable and quality services, such as water, sanitation, housing and waste management. Their availability is essential in ensuring the health and well-being of citizens. Yet, delivery is often constrained by the organization, governance and capacity of the existing framework meant to provide them (Avis, 2016). When this happens, stability can be severely affected as society cannot fulfill its basic needs, and often non-state actors emerge that can take over this role from the government leading to complex power dynamics within a city.

Factors	Categories
Entities Providing Services	Assessment of entities providing services and whether they are state institutions or other groups
Access	Assessment of population access to key resources and services
Infrastructure	Geographic distribution of infrastructure required to provide essential services

BUREAUCRACY

In his essay Economy and Society Weber was the first to postulate that bureaucracy was a fundamental institutional foundation to capitalist growth. In this manner, the Weberian view of bureaucracy and the one we adopt here, is not in the everyday pejorative sense. Rather, it is seen as a set of administrative organizations with specific structural features. Bureaucratically structured public organizations, with their unique decision making procedures, meritocratic recruitment and predictable long term career rewards will be more effective forms of state organization (Weber, 1968). In particular, research has found that meritocratic recruitment and rewarding career ladders may be associated with higher economic growth rates. This is because meritocratic recruitment and meritocracy will increase the likelihood of a degree of competency from those working in these positions and boost morale by developing a more positive esprit de corps (Evans and Rauch, 1999). However, scholars also suggest that the development of highly skilled policy individuals within bureaucratic apparatus creates the potential for power to be usurped from the less knowledgeable politicians involved in the policy making process. Low bureaucratic capacity or fear of punishment should bureaucrats be caught taking actions that are forbidden

by law, both help to dampen the potential effect of bureaucrats seizing too much power. As such the relationship between bureaucrats and politicians is an important element that can sever the democratic links between the citizens and the policy making process.

Factors	Categories
Bureaucracy	Number of individuals employed within institutions
Meritocracy and career ladders	Recruitment pipeline, workplace mobility, compensations rates across positions and time in organization.
Delegation of power	Relationship between bureaucrats and politicians, decree of accountability to politicians.

CONSTITUTIONAL REFORMS

Constitutional reform is the process of restructuring the constitutions and the laws it governs. If done through public consultation and negotiation it can be a way to account for past failures (Dressel, 2005). However, it can also be used as a tool for leaders to seize or maintain power (Burhardt et. al, 2021).

Factors	Categories
Constitutional Reform	Number of Constitutions adopted by the state
Nature of evolution	Transition toward more or less open and inclusive laws
Process	Actors involved in constitutional reform process
Implementation	Laws implemented in accordance to text

JUDICIARY

The judiciary is seen as a mechanism that provides checks and balances in two ways, judicial independence and constitutional review. As such, while the legislature makes the laws, it is independent judges that enforce them without interference from the executive or legislature. In addition, law and policy-makers can be subject to review by the courts (Hayek, 1960). Countries vary in the degree to which they adopt these principles into their constitutions as well as in their implementations leading to a wide variation of relationship between the three branches of governments. The presence of a strong independent judiciary creates a degree of stability as it provides citizens with legal recourse to contest actions carried out by leaders. On the other hand, when the independence between the executive, legislative and

judiciary are not in force, the judiciary can become a tool by which to seize greater power.

Factors	Categories
Access	Ease of access to legal recourse
Appeals	Number of appeals and rate of outcome in favor of state or individual
Independence	Rate of political influence of court rulings

TRANSPARENCY

Citizens assess the wellbeing of their society, in part, based on a number of signals that can be linked to more or less noise depending on the level of transparency. The existence of publicly observable information on the government enables citizens to form shared beliefs. The more publicly observable the information, the easier it is for citizens to update their view on the government's performance (Rosendorff, 2018). Hence, a negative assessment can lead to discontent and eventual mass mobilization resulting in the reduction in stability for a city.

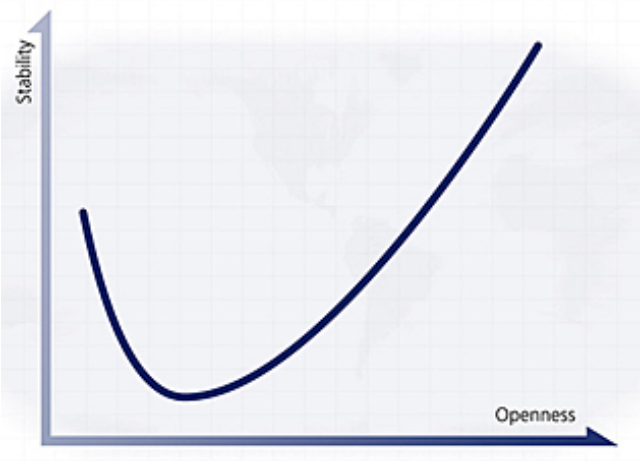


Figure 5.1 The J-Curve

OPENNESS

Openness refers to the degree of financial, economic and political interchange amongst citizens, between citizens and the government, and between the government and the outside world. In assessing how these behaviors of openness affect stability, political scientists have devised a "J-shaped" curve that examines the relationship between a society's openness and its stability. The J-curve suggests that measurements of openness and stability are not sensitive to regime type. This is so as stability can be achieved on either side of the J-curve, either by being fairly closed as may be the case with authoritarian regimes, or fully open. This research suggests that countries in transition between these two states pose the greatest level of instability (Bremmer, 2006). As such, when governments limit the ability to exchange these ideas, goods and services, as well as the available information on its activities, it can serve to control the population and maintain a stable society. On the other hand, openness is characterized by the access and exchange to political and economic processes and information. Such regimes have more stable institutions that rely on existing processes rather than strong or charismatic leaders. While it is expected that states on the left side of the curve, that is those that are highly stable yet closed, will likely lead to instability as the repression and isolation from the outside world is difficult to

maintain, especially with the profuse use of technology world wide.

Factors	Categories
Free Media	Press Freedom Index: Annual ranking of countries based on criteria including pluralism, media independence, media environment and self-censorship, legislative framework, transparency, quality of infrastructure that supports the production of news and information.
Social Media Use and Limits on Access	Ratio: internet penetration/mobile phone use to online presence Censorship Laws Website access restrictions/monitoring

CORRUPTION

Corruption is generally understood as the abuse of entrusted power for private gain (Transparency International, 2021). It takes place when public officials violate formal rules of conduct in pursuit of their private benefit which can be in the form of economic advantage or political gains (Nye, 1967). Therefore, corruption is a process, not an outcome. Often, this abuse of power results in large scale consequences including economic repercussions, unfair competitive advantages and the provision of fewer public services for those who need them most. If corruption becomes widespread public officials (both bureaucrats and elected officials) may redesign programs and create public projects that are motivated by private profit rather than in administering the highest amount of public benefits (Rose-Ackerman, 2005). In turn, this will negatively impact the city´s governance.

MEASURING CORRUPTION

Currently there are various indices and data sources that measure bribery and corruption across countries and industries. The challenge however, is that all of these have been conducted at a country level. Even so, these indices have created the methodology needed to assess corruption in cities.

Factors	Categories
Corruption	Global Corruption Barometer: survey of experiences of everyday people confronting corruption, separated across industries. Corruption Perception Index: composite index from 13 different data sources used to measure public perception on corruption in different countries.

SOURCE MATERIAL

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APPENDIX:

HONG KONG'S UMBRELLA MOVEMENT OF 2014

Appendix

**In order to fully leverage our team's international background, Tianmeng spearheaded the following analysis of the Hong Kong Umbrella Movement. Although her methodology deviates from the G-Sum and GENETICS approaches discussed previously, her proximity to the area of concern and insights into the culture of the umbrella movement ultimately served to inform our model's quantitative values (discussed at the end of this section).*

HONG-KONG UMBRELLA MOVEMENT

Hong Kong's Umbrella Revolution took place from September 26 to December 15, 2014. The Umbrella Movement, also known as Occupy Central, was a social movement that emerged informally and spontaneously from student group actions against the political framework that Beijing had imposed on Hong Kong. The framework was tailored in a manner that would render Hong Kong's Chief Executive in the future elections a "small circle" election. In the details of the framework, all eligible candidates needed approval by half of the 1200 members of the nomination committee that is controlled by the People's Republic of China (PRC). In practice, this meant Beijing would always have an upper hand in securing a pro-PRC Chief Executive, making the "election" non-democratic. Driven by socio-political change, the movement demanded a fair election of Hong Kong's Chief Executive in 2017 elections without Beijing interfering.

The genesis of the movement involved a student-organized protest that escalated into a violent confrontation with police at the Civic Square, just outside Hong Kong's Central Government Offices. The protest gradually spread over to the Admiralty, the eastern extension of the central business district. Later, the protestors commingled with other protestors, the "Occupy Central," spreading the protest further into the Central District and flourishing business areas such as the Mong Kok, and Causeway Bay. The occupiers' key political demand was for the Hong Kong Special Administrative Region (HKSAR) government to enact electoral reforms ensuring future elections of the Legislative Council members, and the Chief Executive, are genuine and democratic.

The movement's main symbol became the yellow umbrella, an

improvised shield that protestors used to defend themselves against pepper spray and tear gas during scuffles with the police. For this reason, the media dubbed the protest movement the "Umbrella Movement/Revolution."

Although the protests were peaceful initially, they grew violent as tension between the police and citizens increased over time. In the later stage of the protests, violent conflicts and clashes between demonstrators and police became more common. Even so, the revolution did not engender positive results since, in the end, the demonstrators' demands were not met.

The Umbrella Revolution's volatile nature sets it aside as an appropriate event to use as our urban destabilization case study. Analytically, the Umbrella Revolution's gradual development from a peaceful protest to a large-scale violent confrontation disturbed Hong Kong's normal operations. This event has some features found in social movements that have developed into violent police-citizen altercations leading to serious urban disruption. Also, the revolution events are significant in explaining how cities may suffer from social unrest leading to their instability.

For this case study, we will apply the GENETICS framework methodology to analyze the disruptions caused by the Umbrella Revolution in Hong Kong city. We will provide the impacts on urban stability based on adaptive capacity, coping capacity, and expectations benchmarks in each stability factor. Also, we will show how the GENETICS framework creates an understanding and analysis of the risks and vulnerabilities that stand as potential threats to Hong Kong's urban stability. Further, we will show how the GENETICS framework can be used as an important tool in analyzing and understanding past events and giving insights into future risks and vulnerabilities to shocks and stress.

GOVERNANCE

The governance factor is important in explaining the challenges that relevant governing institutions in Hong Kong faced during the 2014 urban disruption. To understand the role that Governance Stability Factor played, we will look at how its component metrics contributed to the overall stability of Hong Kong. Also, we will apply the metrics of the governance factor to examine the impact on adaptive capacity, coping capacity, and maximum expectation during the revolution period. Given the governance structure of Hong Kong, this case study will examine three governance levels, namely, the municipal governance, the national governance, and the international presence. It is crucial to

note that Hong Kong does not have to oversee provincial governance.

MUNICIPAL GOVERNANCE

ADAPTIVE CAPACITY

The single-issue political agenda of the Hong Kong Revolution was the quest for the democratic election of the Legislative Council members and the Chief Executive for Hong Kong in a genuine fashion. The protests were a way of defying the reduction in local autonomy. As explained earlier, the new rule increased Beijing's control over Hong Kong. This is an effect that existed before the protests and is still in existence since the protests ended in disappointment. Accordingly, it becomes difficult to respond adaptively to threats due to the existing socio-economic problems and increased tension among the youth and students in Hong Kong (Augustin-Jean and Cheung, 2018).

The national government's action to exercise total control over Hong Kong aggravated animosity and fear over the cultural and political divide between the mainland and Hong Kong. Since 1997, Hong Kong has enjoyed autonomy over its political system and separate currency. To citizens of Hong Kong, the new rule threatened this autonomy that they value so much. Looking at the history of the popular protests in Hong Kong, we conclude that there was a positive effect on adaptive capacity. For instance, the 2013 dock strike, 2011-2012 Occupy Central demonstrations, the 2012 Qingdong incident, and the 2005 and 2010 pro-democracy matches all contributed to the acquisition of relevant experience for local governance in managing social unrest in Hong Kong and preventing urban disruptions.

COPING CAPACITY

The local authority and an effective policy implementation system played a key role in building a strong coping capacity of Hong Kong during the 2014 Umbrella Revolution civil discontent. The government in Hong Kong maintained an effective synergy with the local police force. As a result, the government's enforcement mechanisms were successfully executed by the police. Further, the Hong Kong government exercised absolute authority over the local jurisdictions and policy enforcers. Consequently, the government was able to adapt to the changing environment as it maintained governance services.

The violence and disruption witnessed in Hong Kong in 2014 were contained locally due to its government's

ability to effectively use its local authorities, deploy appropriate enforcement mechanisms, and retain an effective implementation structure. Even though the police confronted the protestors with tear gas and paper spray, they did not deploy any lethal force. Accordingly, widespread use of national government forces was prevented. Borrowing from the previous protests, the use of national government forces and lethal force would have only worsened the protests. It is also significant to note that experience was a key factor for consideration during the protests, given that Leung Chun-ying had headed the Hong Kong government for two years. Nonetheless, the national government exercised high levels of consistency in leadership and influence throughout the government levels, which apparently was informed by a high level of experience. Even as the protests escalated to more intense levels, most government services were in continuity and met general expectations.

EXPECTANCY CRITERION

Throughout the protests, the citizens' perception of the Hong Kong government, especially among the youth and students, became increasingly negative. The Chief Executive's approval rating dropped to 39.7%, and the people remained discontented with the state of national politics. Also, the people developed a negative attitude toward the police due to their aggressive behavior during the protests toward the protestors. Moreover, it is the perceived loss of self-governance that fueled the demonstrations. The same factor led to the expectancy criterion's failure as they lost the autonomy to choose their leaders and play an oversight role as it was their expectation.

Governance - Municipal

Dimensions	Evaluation
Adaptive Capacity	Negative
Coping Capacity	Positive
Expectancy Criterion	Negative

STATE GOVERNANCE

ADAPTIVE CAPACITY

According to Freedom House on Freedom in the World 2020, China is labeled a “Note Free” state with 10/100 (Yeung, 2014). The Human Rights Watch's recent report indicates that to China, human rights is an existential threat. The report cites the actions of the Chinese Communist Party (CCP) to curtail political freedom, suppress criticism, and the building of the “Great Firewall” to prevent the Chinese people from being exposed to the criticism of the Chinese

government from the West. Given this situation, it can therefore be concluded that the state contributed to urban instability in Hong Kong. Since the Chinese government did not have national democratic levels that could hold negotiations to calm Hong Kong's situation through genuine political processes, the adaptive capacity was reduced.

The “one country, two systems" rule that limits Hong Kong’s freedom has a negative impact on its adaptive stability. This is so because of the serious effects that the Chinese government has on the local Hong Kong self-governance freedom. Moreover, the pro-democracy protests in Hong Kong are viewed as a threat to the authoritarian state government. But to the Hong Kongers, the state government is a threat to their autonomy. Further, the CCP, the Chinese government legislature, and the ruling executive do not exhibit diversity in ethnic and linguistic representation. Accordingly, the interests of many people in Hong Kong are not conveyed to mainland China. While there might be diversity within the representation of the state government in mainland China, the same element is missing in Hong Kong. Even part of the Umbrella Revolution was Hong Konger’s fear of losing their culture to an unrepresentative state government. Consequently, it had a negative effect on Hong Kong's stability.

COPING CAPACITY

The Chinese Communist Government contributed to the reduction of their coping capacity. The fear of the national government and the reduced municipal autonomy was pronounced because the people did not trust that the government would offer them a representative of the people. The rule favored a Beijing-based representative and not a people-based Chief Executive. The Chinese government's strong authority can be regarded as a source of strong coping capacity, while to Hong Kong, it is detrimental to adaptive capacity. The adaptive capacity can be seen in the government's ability to exercise direct control over national security forces and implement specific policies on Hong Kong's government. The CCP's government can and, when necessary, intervene in restoring calm in Hong Kong in case the local government is struggling.

EXPECTANCY CRITERION

Most people in Hong Kong expect to keep the state government authority low and maintain autonomy. But as the state influence increases, it stimulates the increase of social unrest. Also, people are

used to the attempt to increase authority by the state government, and they all share negative expectations of the CCP's government. It is, however, the failure of the expectancy criterion in the Hong Kong government that makes people angrier. Judging from this, the state government does not have a strong effect on the expectancy criterion.

Governance - National

Dimensions	Evaluation
Adaptive Capacity	Negative
Coping Capacity	Positive
Expectancy Criterion	Neutral

INTERNATIONAL PRESENCE

Although the international presence is not as significant as municipal and national governance benchmarks, it still holds some influence when considering its relevance to the 2014 protests in terms of occupation and recognition.

ADAPTIVE CAPACITY

Before it was transferred to the Chinese government in 1977, Hong Kong was a British colony. By the time they were leaving, the Britons had engrained their culture, political institutions, and liberal economics within Hong Kong's culture. This unique culture is what most people in Hong Kong fear the Chinese government might suppress that. Facts indicate that some Hong Kong people more strongly identify with the British government than they do with the Chinese government. Generally, they are more adaptive to the British government as it has shaped the thoughts hence their value of autonomy.

COPING CAPACITY

Since it was handed over to the Chinese jurisdiction in 1977, Hong Kong has always enjoyed a special status under the “One country, Two systems.” Nonetheless, to date, Hong Kong has never been recognized internationally as an independent state actor. It is universally recognized as a subsidiary of China. Therefore, as a Special Administrative Region (SAR), Hong Kong cannot receive direct international intervention against its suppression (China). Since it is not a recognized independent national actor, any protests that its citizens engage in are classified as a dissident population.

EXPECTANCY CRITERION

The metrics related to international presence do not indicate any significant effect on the expectancy criterion.

Governance - International

Dimensions	Evaluation
Adaptive Capacity	Negative
Coping Capacity	Negative
Expectancy Criterion	Neutral

CONCLUSION ON GOVERNANCE

In a general view, the contributing governance factors have a negative effect on stability. The analysis shows that both China and Hong Kong have not set conditions that will help prevent future protests from occurring. As such, more protests in the future are likely to occur in Hong Kong. Nonetheless, even though adaptive capacity and expectancy criterion have been identified as weaknesses, coping capacity has proved to be a strength. This is illustrated in the fact that as much as the Hong Kong police acted brutally toward the protesters, they avoided using lethal weapons, which helped evade a potential public uproar and worsen the situation. Moreover, even if the local police were unable to contain the demonstrators, the protestors' chances would require international intervention remaining minimal due to the national government's strength.

ECONOMICS

Hong Kong is an economic marvel due to its strategic position between China and the rest of the world. The genesis of this gem's economic viability dates back to the 1940s when the British colonial government ran a liberalized economy with loose capital controls and low tariffs after the influx of mainland Chinese refugees. In the 1990s and 2000s, when foreign investors started to pump money into China, Hong Kong played an intermediary role. In 1997 when it was handed over to China, Hong Kong accounted for 80% of foreign direct investment (FDI) into Guangdong province of China (Lin, 2020). In 2018, Hong Kong was solely responsible for a remarkable 60% of the overall FDI flowing in and out of China (Lin, 2020). Since 1977, Hong Kong has remained a critical player in transforming China's economy, more especially posing as a vital conduit to Chinese capital seeking investments abroad. Even with such a mantle, we can still argue that the Chinese government can seamlessly afford the economic loss during the three-month Umbrella Movement protest.

ADAPTIVE CAPACITY

Even though Hong Kong has experienced other protests before, the Umbrella Revolution protest was

specifically aimed at the Chinese government. Given its economic structure, Hong Kong exhibited a positive effect on its adaptive capacity. This is mainly due to the neoliberal economic policies which were created in the 20th century from the creation of legal and economic institutions that protect the market from state intervention. Although the economic policies operate effectively in Hong Kong, separate legal institutions allow for the erosion of market protections upon which capitalism largely depends. This makes investors feel reassured since political activities cannot interfere with profit. Given that the authorities can violently crackdown on those who cause urban disruption, China's authoritarian regime becomes attractive to western investors.

The free-market principles that govern the Hong Kong economy are the reason for the market's quick adjustment to interest rate exchanges and other financial shocks. Hang Sheng submits that the 2014 protests only caused a 6 percent drop in the economy instead of the market watcher prediction of a 15 to 20 percent decrease. Suppose the protestors' goal was to cripple the economy so that the regime can recognize their impact. In that case, the slight margin in economic loss might be the reason why their grievances were never responded to. Although the demonstration occurred in the major business centers in Hong Kong, causing a slowed GDP growth in the fourth quarter of 2014 (GDP Quarterly, 2014), Hong Kong still recorded an increase in retail sales in the same year compared to 2013 over the same period. Equally, imports and exports showed an improvement.

This shows that despite the prevalence of the protests, investors and tourists still had high confidence in Hong Kong (Headler and Tanigawa-Lau, 2016; HKTB 2014). Hong Kong is not immune to future demonstrations. The widening gap between the poor and the rich will not be the government's use of public policy to boost financial stability. It is also vital to address the deteriorating sociopolitical situations and structural challenges such as income disparities and insufficient housing supply. These challenges affect the city's competitive advantage in the long term by further weakening economic activities. The Umbrella Movement protests reflected a high level of informality in the city. The protestors were fueled not only with an aim to restore the mandate to elect their leaders democratically but also to reclaim and restructure income distribution, supply of housing, and land redevelopment.

COPING CAPACITY

Fig 6.1: A ship carrying the slogan 'celebrating the 23rd anniversary of Hong Kong's return to the motherland' in Victoria harbor, Hong Kong. Source: The Guardian.

Before the crisis, Hong Kong benefited from its sound financial system, exceptional fiscal policies, and healthy foreign currency reserves, creating a responsive economy. However, during the 2014 Umbrella Movement protests, the market connectivity negatively affected the city's coping capacity. This is due to the fact that the city is a center of the financial market, and the prevalence of demonstrations within the Hong-Kong disrupted the influx of money from international investors, especially so from those in mainland China. Investors became highly insecure, creating a negative effect on financial stability. Moreover, the city's resilience was affected by high levels of informality caused by the protests. The protests also worsened the economic situation on an individual basis since Hong Kong is on record as one of the world's most income inequality places. Consequently, it can be argued that most people are facing financial difficulties due to economic shock from the protest.

EXPECTANCY CRITERION

Hong Kong did not meet the expectations of its citizens. Even though the macroeconomic indicators show a positive economic growth adjustment, the effect does not apply to the low-income earners and the unemployed. Accordingly, a segment of the society still suffers from Hong Kong's public policy. Also, it is important to note that it may take longer for the city to recover from the stress experience in 2014. But even so, the statement was made. The Umbrella Movement will forever be remembered as an emblem of unmeasurable political power, and it will be a north star for future generations in terms of civil awareness. Away from the local sphere, in the international space, the movement has a name; it has since gathered international media attention, and in the future, it might get global support.

Economics

Dimensions	Evaluation
Adaptive Capacity	Neutral
Coping Capacity	Negative
Expectancy Criterion	Negative

Although Hong Kong did display the ability to cope with economic loss based on fundamental economic loss, economic inequalities and financial inclusion dominated and still dominated the coping capacity of the city's resilience. The city's overall adaptive capacity received a neutral effect because, despite the protest, international investors still held high confidence in Hong Kong. The expectation of the citizens toward their government was never met. And this is illustrated even in their dissatisfaction with the election rules and the financial disparities among Hong Kongers. The two, among others, still present as the possible causes of future protests. Going by this, we conclude that the overall expectation is negative.

NATURAL ENVIRONMENT

During the 2014 Umbrella Revolution protest, Hong Kong did not experience any significant environmental disruptions that could trigger the Chinese government to loosen its authoritarian policies. In that view, we concluded that it was not important to cite the environmental disruptions that could lead to urban instability because they were not significant during the protest. Hong Kong enjoys a subtropical climate which is characterized by four seasons. The seasons result from the north-northeast monsoon winds that last from October to March and the South-southwest monsoon

winds, which last from April to September.

The period between October to November is the best time to visit Hong Kong since the skies are usually clear and the temperature is warm. At the time of the protest, September to December, the climate was warm but not too hot. It favored interactions. No major natural disasters resulting from the climatic condition occurred during that period. Moreover, there was no level of adaptation needed to prevent the effects of movement and provide urban stability. We think it is important to note that even though Hong Kong did not experience any natural disaster during the protest, that does not mean the case will be the same. We speculate that future environmental disasters could lead to a build-up of deadly protests driven by the impacts of protests such as the Umbrella Revolution. Therefore, when analyzing future potential causes of urban disruption in Hong Kong, the natural environment should be a factor to consider.

ADAPTIVE CAPACITY

When we analyzed adaptive capacity regarding the natural environment, we were guided by the three elements; awareness, flexibility, and Hong Kong's government's ability to prepare and respond to environmental hazards and threats that might occur. According to Hong Kong's Climate Action Plan 2030+, the city is highly aware of the significance of climate change control. These practical set goals to increase the use of renewable energy while working toward its climate goals by 2050. Even though these ambitious goals certainly play a vital role in mitigating future environmental risks, we didn't consider it since it didn't have a notable role in the Umbrella Revolution protests. Hong Kong prides itself on some of the most effective and modern flood and hurricane mitigation mechanisms, thus very flexible. Moreover, the city's connection to China provides it with an unlimited supply of water, food, and natural resources. The Umbrella Revolution did not by whatsoever means inhibit the city's environmental adaptability. As such, we rate it neutral.

COPING CAPACITY

We analyzed Hong Kong's coping capacity based on the city's geographical location and its topography. The Umbrella Movement protest might not have morphed to be lethal because the city's mountainous nature made it difficult for protests to protest. The same case applied to the government response units. They found it difficult to respond since the protestors were diffused throughout the city due to a lack of gathering spaces. For the Chinese government, the response was difficult due to limited access points to the island (Anderson, 2016).

It can also be argued that the natural geography of Hong Kong plus the culture created by the British fueled the 2014 protest. The separatism impulse in Hong Kong could have been a result of geographical-based separation (Ryabinin Yevgeny, 2017). Apart from the students and Occupy Central groups, some nationalistic isolationist attitudes contributed to the rebellious activities against the government. Also, the weather did play a critical role in creating a favorable environment for the protest since fewer people would be interested in a protest if it were flooding outside. However, this should not be misconstrued that good weather causes instability in urban centers. Thus far, there is not much significance that we can attach to the natural environment as a source of urban disruptions in the 2014 Umbrella Revolution. We, therefore, rate the coping ability of Hong Kong as neutral since there are not any notable environmental hazards attached to the unstable environment during the protest.

EXPECTATION THRESHOLDS

The thresholds of the population in Hong Kong were subjected to pressure by many factors but environmental factors. We did not identify any environmental factors that could be linked to the protest. Accordingly, we ruled out expectation thresholds as inconsequential and therefore considered them neutral.

Natural Environment

Dimensions	Evaluation
Adaptive Capacity	Neutral
Coping Capacity	Neutral
Expectancy Criterion	Neutral

ENERGY

Throughout the protest, the energy system was able to match demand and supply consistently. This is because the Umbrella Revolution protest was not motivated by energy as a factor. As such, energy remained neutral in terms of contribution to the protest. As a vital resource in Hong Kong's stability, energy could have in many may lead to instability of the city if it was stressed. These criteria maintained a neutral position by supporting both the protestors and the government response team. The system maintained its day-to-day services, and as the protestors raised tents along the city streets, they powered their charging systems, WI-FI, and lighting systems with local generators and wind-powered turbines (Ming Pao News, 2014; Hume and Park, 2014). For the larger Hong Kong society, energy and electricity consumption operated as normal

throughout the entire protest period in 2014.

ADAPTIVE CAPACITY

We identified Hong Kong's energy system adaptive capacity as neutral since it played zero roles toward the city's stability during the Umbrella Revolution. Considering the subordinate criteria, awareness, flexibility, and ability of the Hong Kong government to prepare and respond to the stressor, none of them contributed to the city's emerging challenges. Efforts to modernize the energy system and increase its flexibility began after the protest had faded. Records indicated that between 2016 and 2018, two primary electric companies initiated their smart grip initiatives (EMSD, 2018). Apparently, that is a year after the 2014 match on the Hong Kong streets. Given that there were no changes in the energy system based on the three subordinate criteria, we rated the energy system's impact on Hong Kong stability during the Umbrella Revolution as neutral.

COPING CAPACITY

To establish the energy system's impact on Hong Kong's stability during the Umbrella Revolution, we focused on supply diversity. Data shows that Hong Kong produces 77% of its domestic electricity needs (CLP Group). To fill the remaining gap, it relies on mainland China. This energy source is mainly coal, but it also relies on natural gas generation and nuclear energy (HK Electric, 2018). All the coal that Hong Kong uses to generate energy is imported from Indonesia. The nuclear power that is used to generate power is based at its neighboring province, Guangdong. Also, all the natural gas it uses is sourced from a China-owned field.

Hong Kong fills its energy needs from oil and gas, with Singapore being her dominant oil supplier. Even though energy demand and supply were not a factor to consider during the Umbrella Revolution, Supply Diversion concerns could have contributed to Hong Kong's destabilization. Therefore, there could have been minimal chances to cope with any stress directed at this energy supply system.

Further, Supply Diversity concerns serve a potential energy system coping capacity that is primarily linked to node centrality that either the Chinese government or the protestors could have leveraged. To understand how this node centrality operates, we have to contextualize the Hong Kong energy Supply Robustness.

Hong Kong has two major companies that monopolize its power distribution; the Hong Kong Electricity Company Limited (HK Electric) and the CLP Power Hong Kong Limited. The two companies operate five facilities that generate total electricity. On top of that, CLP manages the Daya Bay Nuclear Facility contract and operates a pumped-hydro storage facility (CLP). The importation of coal and oil occurs only at Tap Shek Kok on Castle Peak Power Station owned by CLP, and Po Lo Tsui on Lamma Island Power Station owned by HK Electric (Lu and Wang, 2018). Given such a robust supply system, if the state government decides to restrict power transmission from Daya Bay Nuclear Facility or block energy supply into Hong Kong at the ports, the energy system could have experienced quite a hard hit. Accordingly, the blockade and restriction could have caused significant instability in Hong Kong.

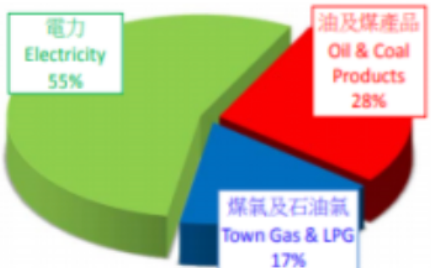

Fig 6.2: Hong Kong End-Use energy data in 2014. Source: Hong Kong End-Use Data 2017.

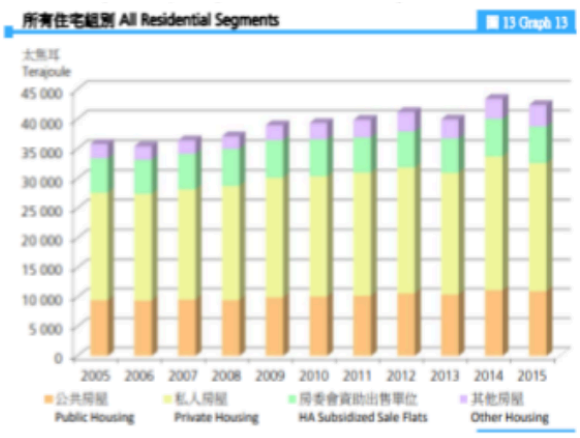

Fig 6.3: Electricity consumption by End-Users in Residential Segments. Source: Hong Kong End-Use Data 2017.

EXPECTANCY BENCHMARK

The coping capacity criteria had virtually no impact on the stability of Hong Kong during the Umbrella Revolution. Supply and demand consistently matched. The generation, transmission, and storage were all at equilibrium. There was no improvement or retrogressive service, nor was there a need for system maintenance due to the protest's actions. Although there is no data on how the Hong Kong citizens perceived changes in the energy system capabilities, the World Bank does provide crucial data worth noting. The report indicates that CLP and HK Electric registered an availability rating of 99.9% (Fig 3) throughout the protest. Further, in terms of the World Economic Forum Global Competitiveness Index, Hong Kong's electricity supply quality was among the world's top-rated electricity supply systems. On a scale of 7, Hong Kong-registered 6.76 in 2014 and 2015, as

shown in Figure 3. As per this data, we submit that Hong Kong had a high energy system expectancy benchmark. This is because there were no protests due to a lack of any form of energy, gas, or electricity. Accordingly, it had a neutral impact on the stability of Hong Kong.

Although the energy system had the potential to contribute negatively to Hong Kong's stability during the 2014 protest, it remained neutral throughout the stint. The adaptive and coping capacities, as well as the expectation benchmark levels, were relatively sufficient. This ensured that the protest did not disrupt the energy system. Moreover, they never acted as the cause of the social unrest.

Energy

Dimensions	Evaluation
Adaptive Capacity	Neutral
Coping Capacity	Neutral
Expectancy Criterion	Neutral

TECHNOLOGY

The Umbrella Revolution was characteristically spontaneous with large amounts of participants. Starting from university students, the social movement escalated dramatically to mammoth proportions, with the other citizens joining to express their distresses (Lee, Clement and Leung, 2015). All this spontaneity and mushrooming of the protest was aided by technology and media. Participants of the movement thought of themselves as autonomous individuals that connected to each other through consensus.

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ADAPTIVE CAPACITY

Digital narratives on social media, where the term ‘Umbrella Movement’ was coined, acted as a platform to showcase the rise of personalized politics among the youth interested in their country’s environmental protection, workers and human rights, as well as economic justice. With smartphones, it was easier to raise, discuss and give way forward on some topics. Alternative views and collection action were shared on websites, social

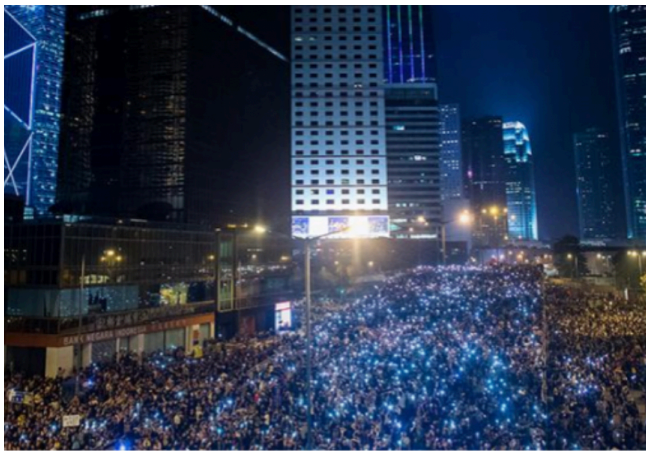


Fig 6.4: A sea of lights coming from thousands of Hong Kong protesters waving their lit up mobile phones in the darkness. Source: qz.com

media, and WhatsApp. For instance, as the protest morphed into bigger proportions, information and opinion sharing was done at the Hong Kong Golden Forum on Facebook, Tumblr, WhatsApp, and a website with the domain name, Discuss.com.hk.

Social media served as an insurgent public sphere (IPS) for protestors during the movement. The students and other youth used social media to mobilize people, act against the government, and reduce the Hong Kong and regional police's satisfaction while increasing support for the movement. On the other hand, mainstream media conveyed political information to the public. Most of the information conveyed resulted in the polarization of opinion among the public, thus heightening political temperatures and creating more support for the movement. The destructive ability of social media was manifested at this period of great controversy. Controlling the flow of information was difficult due to the autonomous construction of social networks (Lee, Clement and Leung, 2015).

COPING CAPACITY

With new technology, protestors were able to maintain their anonymity online through encrypted apps. End-to-end encryption and online anonymity facilitated the mobilization of leaderless protest. The government could not predict, prepare, or respond effectively to the demonstrators' moves due to the negative influence created by the media's spread concerning coping capacity. For instance, Beijing could not decide as it depended on information from the Hong Kong Liaison Office. Also, different mainstream media distributed varying understanding of the protestors' motivation, goal, and grievances.

On the other hand, the protestors distributed their information through different social media. All these created further misunderstandings and confusion, thus triggering further instability between different government response teams. Moreover, the HKMap.live, although Apple removed from their App Store later, was

used by the protestors to track the police movements. This was advantageous and a motivational factor for people who could have otherwise avoided the streets in fear of facing police brutality. Also, for the Hong Kong hackers, this was a moment to shine. Together with students, the hackers hacked the government websites, making them porous. Students attacked more than 11,500 attacks on police websites, and as a result, they could target and ambush them.

EXPECTANCY BENCHMARK

Technology was used to peddle information based on an individual user's interests and concerns. This technology-facilitated personalization of information proved it difficult for the police to limit information sources or tune all the information toward one agenda. Also, smartphones served as a link between Hong Kong and the rest of the world. Accordingly, the global audience participated in the movement through discussions and sharing of thoughts. On a broader scale, technology was a battlefield during the protests. Through social media, people shared, discussed, and planned the execution of various plans. The role that technology played in the protest reflects future protests and the place that technology will take. Technology enhances political participation, encourages interpersonal conversation on various agendas, includes controversial topics, and enables sharing information with the public. This shapes the citizens' expectations in future social-political movements and arenas to express individual opinions.

In conclusion, technology had a neutral impact on adaptive and coping capacities. With an expectancy benchmark, it has a positive impact. Social media took a central role in the distribution of information, thus creating public awareness. Moreover, it played a key role in polarization and organization of the protest. Misinformation and confusion created from varying information shared on mainstream media facilitated delayed and inadequate government response. Social had a positive effect on people's expectations as it facilitated connection to the rest of the world. After these considerations, we concluded that not only did technology facilitate the instability, but it was also used as a tool to mitigate further protesting. Additionally, it was used to set conditions for increased stability in the future. Overall, technology had a neutral impact on adaptive and coping capacities and a positive impact on expectancy benchmarks.

Technology

Dimensions	Evaluation
Adaptive Capacity	Neutral
Coping Capacity	Neutral
Expectancy Criterion	Positive

INFRASTRUCTURE

Hong Kong is a highly developed city. The citizens have access to the superb infrastructure that meets their needs and contribute to the development, growth, and efficiency of the economy. The city's railway system is among the most efficient systems in the world. It is connected to mainland China through the Kowloon peninsula, thus creating freight links essential for the city's future expectations. The land transport system is made efficient since the government encourages public transport to reduce the levels of air pollution. The same organization and efficiency are witnessed in sea communications, air transport, energy generation, and telecommunication systems.

The protestors occupied open places such as the streets, squares, plazas, and boulevards to achieve maximum visibility and movement. Moreover, the organizers found this approach the best way to impact the city's operations and urban expectations benchmarks. Hong Kong is made up of the Hong Kong, Lantau, and Tsing Yi islands. The central business district (CBD) is located on Hong Kong island, with the city's major occupying the rest of the two principal islands. Bridges and tunnels play a key role as infrastructures since they connect the islands by carrying people, cars, trucks, trains, and busses. Another important feature is that Hong Kong is one of the most densely populated islands globally. In the northern part of Hong Kong island live an average of 90,000 people per square mile.

Given the significance of the tunnels and bridges to the CBD, blocking them would mean halting operations at Hong Kong's heart. "Occupy Central," a part of the Umbrella Movement, aimed at crippling down the CBD. The movement occupied and closed critical links to the CBD through mass mobilization of protesters, bringing it to a grinding halt. The protestors filled tunnels and bridges connecting the CBD to the rest of the city. However, the police response helped to loosen up the situation.

Another way that the city's operations could have been halted was by protesting and gathering on the subway system. However, in Hong Kong, the MTR corporation operates the subway system as a private entity. Accordingly, holding

protests and gatherings on the subways could have been considered a trespass on private, an action punishable by law. Further, even though protesting in subways could have been an effective way to hinder movement around the city, huge protests could not be visible as they were in streets, plazas, and other open-air spaces. Furthermore, that kind of protest could not attract a large number of protestors. Nonetheless, as the protestors occupied the above-ground public spaces, the subways became the city's lifeline. During the entire protest period, the subway system saw a 20% increase in ridership19. This is actually against the expected outcome, given that businesses in the CBD were closed. But factoring in the fact that bus and train operations were suspended to avoid collision with the protestors, it is not surprising that the subways recorded an increase in activities.

Hong Kong showed a high level of coping capacity due to its highly developed infrastructure. The blockage of one infrastructure did not stop daily activities in the city due to the availability of multiple alternative infrastructures. Also, multiple infrastructures created high flexibility, especially in the transport sector. Therefore, the adaptive capacity for citizens was functional. Another coping and adaptive capacity that was notable is that; At the same time, the subway system facilitated the movement of people, food, water, and other services and goods from and to schools, governments institutions, hospitals, among other places, they also helped people from all areas of Hong Kong to join the protest. In that view, if the government closed down the subways, it could have reduced the number of people joining the protest movement. Nonetheless, closing it down could not be an effective move since it could halt operations in the city, and that way, the “Occupy Central” protests could have achieved their goal.

Infrastructure

Dimensions	Evaluation
Adaptive Capacity	Neutral
Coping Capacity	Neutral
Expectancy Criterion	Positive

CULTURE

To analyze the role that culture played in the Umbrella Revolution, we focused on the two most important criteria; identity and education. Other criteria that could have been used include; community support criteria and medical criteria. However, since the social movement did not arise due to unequal distribution of resources in the community and it did not cause any

significant damage to the vulnerable groups, the community support criteria cannot be applied here. Equally, the medical criteria are not applicable in this case study because the protests have nothing to do with the medical system in Hong. The only role that the medical system played was providing medical care to those injured during the protest. This is a role that had no link with the initial goal and aim of the protests.

Between 2008 and 2014, Hong Kong's adult (15+) literacy rate remained stable at around 99.0%, as shown in Figure 5 (Word Data Atlas). This data was obtained based on all Hong Kong citizens ages 15 years above to read, write, perform simple arithmetic calculations, and understand simple statements. However, looking at specifics, 22.1% of citizens aged 15 years and above in Hong Kong had received a university education in 2014. Those with secondary level education accounted for 50.5%, and 19.7% had received primary level education or below (Education Bureau). In comparison, statistics show that by 2011, 30.1% of Beijing's population had tertiary education. Those with primary school education or above accounted for 94.07 %. This data is important as it helps explain the role that education levels played in the Umbrella Revolution.

As stated earlier in this case study, university students from Hong Kong were the Umbrella Revolution organizers. They rallied peaceful demonstrations to demand their right to be heard and understood. The students remained peaceful in their demonstrations even when they entered the occupy central phase. But as the protest attracted different classes of citizens, violence and conflict started to phase-in. This can be attributed to the fact that some of the people who joined the movement had low education levels and could not understand how a peaceful protest could invoke the government's response. To them, a rough and violent protest was the only means to get the government to listen to them. In that view, low education had a negative impact on the Umbrella Movement.

Identity factor flourished within the 79 days of the protest. Cultural artifacts and performances were abundant during this period. The younger generation, which made the larger percent of the protestors, adapted creativity and improvised ways to express themselves. The streets were decorated with yellow ribbons, yellow umbrellas, and a touch of black. These colors have since been interpreted to depict 'symbolic politics' (Günther, 2016). Symbolic politics was a way to attract public attention and

gain recognition. This strategy worked out successfully. Further, through symbolic politics, the public's pre-existing values could be shaped to embrace collectivism and think about themselves against the government. Apart from shaping the movement's identity, symbolic politics could empower individuals and aid in transforming the political landscape in Hong Kong. While the protest ended in disappointment, people were able to connect and think as a collective whole due to symbolic politics. This created a positive impact toward the movement.

Further, identity culture was portrayed in the three main protest sites; Causeway Bay, Mong Kok, and Admiralty. All these sites were marked with exceptional performances and ‘guerilla’ aesthetics. To underscore the umbrella and the yellow ribbon as the Icon of the movement, young people sculptured the 'Umbrella Man.' The sculpture was made of wooden blocks and towered 12-feet tall. It held a yellow umbrella, a feature symbolizing the movement. Another notable feature was the ‘Memo Wall’ or the ‘Lennon Wall of Hong Kong.’ It was made from more than 250 umbrellas that had broken and worn out during the scuffle with the police. The ‘wall’ was located outside the Central Government Complex with memo stickers plastered all over it. Also, they hung a huge yellow banner carrying the message, 'I want Real Universal Suffrage,' Lion Rock mountain. Other performances include the projector that displayed messages from supporters around the world, the salient parade, and use of songs. All these performances generated a profound impact on the movement. In a broader view, they indicated the new generation's understanding and expectation of democracy.

Also, the older and younger generation's evaluation indicated disagreements on the way elections and the government, in general, should operate. For instance, in a poll conducted on November 23, 2014, to establish the impact of the Umbrella Movement, 42 percent and 43 percent of the people aged below 18 years old and those between 18-29 respectively supported the protest, while the older generation (60 years and above) were against it. The results of the poll indicated that the two generations have divergent views. Additionally, these differences manifested even in the operation of Hong Kong's legal system. While 38 percent of people ages below 18 years, and 32 percent of citizens ages between 18-29 disagree that breaching the injunction would be breaking the rule of law, 90 percent of the citizens aged 60 and above agree that breaking the injunction would result in

undermining the rule of role. The conflict and violence can allude to these differences, but this was not the motivation behind the Umbrella Revolution; the attack on universal suffrage did.

The Umbrella Revolution could have been possibly fueled by identity deviation among the Hong Kongers. Given the history of the territory, Hong Kong citizens wandered between the Chinese and British identities. During the British colonial period, Hong Kong's political and educational systems were weaved under the British culture. Even though the people would speak and dress like English men, they could not be recognized as true English men. As an immigrant city, Hong Kong is home to many Chinese from the mainland. Many Chinese citizens on the mainland trace their ancestry back to Hong Kong. After the city was handed over back to China, many Chinese people came back to Hong Kong. Since then, there has been a conflict between the Chinese and the Hong Kongers. In the poll that has been conducted in the city, the people were asked to choose their identity either as Chinese or Hong Kongers. Most young people identified themselves as Hong Kongers. Given the difference in the Hong Kong people's identity toward the Chinese, the Umbrella Revolution attracted Hong Kongers in large numbers because they felt threatened by the new rule.

The protest attracted such a mammoth gathering not just because the people were demanding voting rights. The main issue is that Hong Kongers wanted to express their dissatisfaction with their socio-economical aspect of life. It is undeniable that the city is renowned globally as an international financial hub and for its modern lifestyle and prosperity. However, the reality is that many Hong Kongers have for a long time been living under pressure from difficult living conditions. Some of those include; high housing prices and housing supply problems. Consequently, they had been living with mental stress and subjective mental loss. Most young people were more active in the Umbrella Revolution because of the frustrations they face in their daily life and the feeling of despair about their future. With such high housing prices, most of them will never afford their own houses in their lifetime. According to an article on East Asia Forum, “Hong Kong’s housing is the most unaffordable in the world. Median income households have to spend 20 years of their earnings to buy a 60 square metre flat at an average cost of $US1.24 million” (Yip, 2021). The housing problem is such a sensitive issue among Hong Kongers today and will continue to invoke

emotions in the future. Given this level of dissatisfaction among the people, it is highly likely that people will take to the streets to protest over the same issue in the future.

Culture

Dimensions	Evaluation
Adaptive Capacity	Negative
Coping Capacity	Neutral
Expectancy Criterion	Negative

SECURITY

To China, the need to enforce law and order in Hong Kong is of paramount interest. Before we delve into the evaluation of security factors, we first look at Hong Kong's journey based on the security law and the latest enactments on security for contextualization. After Hong Kong was handed over to China in 1997, two agreements were made on how the territory's governance would happen. One, Hong Kong was to have a mini-constitution, the Basic Law. Two, China was to rule over Hong Kong based on the "one country, two systems" principle. This agreement was supposed to protect certain rights and freedoms for Hong Kong; first, assembly and speech freedom. Second, some democratic rights and an independent judiciary. Note that people in mainland China do not have these freedoms. The most important part of the agreement and one that is relevant to this case study is that Hong Kong was allowed to enact its national security law. Although this was spelled out in Article 23 of the Basic Law, it never happened because it was unpopular.

Lately, apart from the Umbrella Revolution, Hong Kong has experienced several pro-democratic and anti-China protests. Beijing is not comfortable with this social unrest and views them as a threat to national security. For that reason, recently, China has introduced a new security law to ensure that the city has a legal framework that can deal with what it terms as "serious challenges to its authority" (BBC News, 2021). The details of the law which were kept secret until it was passed include criminalization of the following; "secession – breaking away from the country, subversion – undermining the power or authority of the central government, terrorism – using violence or intimidation against people, and collusion with foreign or external forces" (BBC News, 2021). According to critics, the law is a breach of the "one country, two systems" principle. However, Beijing found some way to do it anyway. Now, mainland China has the power to control and shape the life of Hong Kongers. That also means that the progress of all pro-democracy movements

in Hong Kong has been curtailed. Even before the recent security law, Hong Kong enjoyed a robust security apparatus capable of handling any acts from destruction from protestors while avoiding escalation toward either significant security crackdowns or complete loss of safety and control over the situation.

MILITARY FORCES

China's army, the People's Liberation Army (PLA), is one of the world's largest. The Army, Navy, Air Force, and the Second Artillery Force, all accumulate to a staggering 2.3 million personnel in estimation. The army is a significant and overwhelming force relative to the population of Hong Kong. However, it faces challenges such as personnel quality, outdated command structures, corruption, some cases of lack of professionalism, and weakness in conducting large scale integrated and joint operation (Günther, 2016). The PLA's loyalty lies with the Chinese Communist Party. Therefore, it is very secretive in its interaction with other government organizations, which makes it impossible to establish its involvement in the Umbrella Revolution protests in Hong Kong. The Army's solemn role is to protect Chinese sovereignty. Therefore, the ideology of a semi-autonomous government peddled by Hong Kongers is a provocation to the PLA, and it could necessitate their stepping in to control the situation. In that case, the army can be viewed as a threat to the security stability of Hong Kong.

ADAPTIVE CAPACITY

Acquired during the handover to China, Hong Kong's mini-constitution or the Basic Law allows the PLA to active operation in Hong Kong if a critical situation arises. Such a move is very sensitive, and Beijing has always been reluctant to pick it as the most viable, especially during pro-democracy protests in Hong Kong. However, the Army has not shied from expanding its presence in the territory. For instance, months before the Umbrella Revolution, the PLA tried to expand its presence in Hong Kong by constructing a PLA-specific harbor along the waterfront. Opposed to their operations and presence, it did not take long before Hong Kongers from that locality launched immediate protests and broke into the PLA's garrison. The PLA spokesman at the time reprimanded the act. He submitted that there could not have been a better indication that the Special Administrative Region, Hong Kong, needed an increase of the PLA's presence.

Further, the PLA attempted to send fear among Hong Kong citizens by driving

through the city with armored vehicles mounted with guns. This happened months before the Umbrella Revolution as a sign to warn the people against the protests. This was Beijing's technical approach to exercising authority while maneuvering the law's tight constraints and non-interference status-quo. Nonetheless, the Army's limits were tightly bound by "association of PLA armor and civilian protests from 1989" (The Straits Times, 2016). When the protests began, the mainland official, state media conveyed messages of warning to Hong Kongers, criticized the protests, and hinted at the PLA forces' involvement if the protests did not stop (Los Angeles Times, 2014). To confirm this, there was an increase of SUVs with unmarked military license plates roaming around the city. This indicated the presence of the PLA forces. Moreover, there was an increase of activities around the PLA garrisons. All these were clear indications that the military was adapting to the situation that was building. Also, in the previous protests, mainland China has been involved in intimidating the protestors. For instance, on June 4, 1989, the world watched in horror as the Chinese military cracked down on student protestors in Tiananmen Square. The military has also been used to give threats to protesters' lives, hacking, and even threatening family members.

COPING CAPACITY

The numerous PLA-related facilities around Hong Kong indicate PLA troops' presence, including the naval and air force personnel. The Hong Kong PLA forces, formerly known as the Prince of Wales barracks under British rule, are headquarters to around 6,000 to 10,000 troops. Of this number, none of the soldiers are recruited from the locals, nor are they allowed to interact with them even when they are off-duty. Many other forces are stationed outside Shenzhen territory. This study considered the Hong Kong PLA forces since their garrison is not located far from where the protests were happening. According to the Hong Kong Basic Law, the PLA troops stationed in Hong Kong are meant to "defend" and "shall not interfere in the local affairs of the Region" (Article 14). Even though the law stipulates that the Hong Kong government can "ask for assistance from the garrison in the maintenance of public order and disaster relief," the law underscores that this can only be done with utmost adherence to the Hong Kong law. Further, Article 18 makes it clear that most mainland Chinese laws do not apply in Hong Kong apart from the case where the National People's Congress decides "to declare a state of war or, because of turmoil within the Hong Kong Special Administrative Region which endangers national unity or security and is beyond

the control of the Region, decides that the Region is in a state of emergency, [then] the Central People's Government may issue an order applying the relevant national laws in the Region" (Davis and Tinbor Hui, 2019; Legislative Council Secretariat).

EXPECTANCY BENCHMARK

The Hong Kong citizens share a mixed perception toward the military forces. On one side, a strong military is a nationalistic pride. They feel secure living in the city since they believe in the protection ability of the military. However, the military has been used as a tool of oppression before. For instance, people share the memories of Tiananmen Square and how the military cracked down on unarmed protestors. If the mainland Chinese government met such a heinous act on students whose only offense was to peaceful demand for their rights, a repeat of the same horror cannot be dismissed. Furthermore, their fear can be supported by the recent 2012 protest in Tibet where the military was involved, and some protests were killed.

There have been rumors that the PLA was used to control the city's situation during the Umbrella Revolution protests. However, the Beijing government has quashed those claims, stating a little likelihood of the same occurring31. We base the argument of the statement offered by the government. If there was a 'little' likelihood, surely there is a probability that the military was deployed, especially when violence and conflict broke out between the police and the protestors. The Beijing government was particularly cautious about the PLA's involvement in the protests given the previous outcomes and the concern that it might attract international response. The security forces in Hong Kong stated that they did not believe in the military's involvement from the PLA garrison in Hong Kong. This they did in a move to relax heightened tensions among the civilians. However, some citizens remain adamant, believing that the Beijing government was involving the military in the protests.

Nonetheless, the tensions did not morph into anything substantial that could trigger the government to act up. Moreover, the public's opinion translated to the PLA garrison's approval rating in Hong Kong stood at 63.1% (HKU). We could not prove much about this relationship. Still, the action to assist firefighters in responding to a fire that had broken out at the PLA compound in the city is clear proof of this untwisted relationship. Suppose the locals were holding a grudge against the military. In that case, the outcome of such an event

could have been different, considering that the firefighter did not know the route to access the fire site in the shortest time possible.

Security - Military Forces

Dimensions	Evaluation
Adaptive Capacity	Neutral
Coping Capacity	Positive
Expectancy Criterion	Neutral

NON-MILITARY FORCES

In this case, we look at the People's Armed Police (PAP). It is a Chinese paramilitary organization whose primary role includes; law enforcement, maritime rights protection, counter-terrorism, riot control, internal security, and disaster response. More importantly, the PAP provides support to the PLA Ground Force during wartime. It was created in 1982 Freedom House Report, 2019) for two purposes; to increase the professionalization of security apparatus and to absorb numerous PLA personnel that were demobilized during a time when social unrest was on the rise, more especially during the Tiananmen Square protests. Although the total strength is not known, the PAP is believed to be 1.5 million strong. PAP is virtually a subsection of the PLA, but by law, it operates separately from PLA. Given that the PAP concentrates on managing mass incidents and protecting important facilities, it plays a big role in countering protests and social movements.

ADAPTIVE CAPACITY

During the Umbrella Revolution protests, the security forces found it hard to adapt to the growing movement simultaneously operating from three different locations. This is because the Hong Kong security forces are not trained to handle such a massive protest. Instead, they are best suited for handling small and centrally located protests. When they were confronted, they responded by using pepper spray, which the protestors adopted using umbrellas. Eventually, the forces threw tear gas canisters at the protestors, but they blocked them using umbrellas. All this while, the protestors assumed positions that could not seem as threatening to the police forces. Nonetheless, what was threatening to the police was expanding the movement when more and more people joined the movement.

As the protestors increased, so did tension among the security forces. They responded with more teargas and tried to clear off protestors' camps along the streets. However, the protestors kept coming back, which triggered further tension and escalated responses from the

police. The police employed the use of batons to push the protestor back. They arrested, dragged, and shuttled away from the protestors, some in ambulances. The police and the protestors' back-and-forth resulted in peaceful acts of disobedience, followed by chants and taunts. By the end of the protests, the police had arrested approximately 1000 protestors, and there were a few casualties on both sides (Human Rights Watch, 2015).

Weeks into the protests, the police became more reluctant and changed their response tactics. The use of tear gas and pepper spray was dropped, and waiting on the protests became the new norm (Bush, 2016). Moreover, they chipped away at the edges of the protestors' encampments to reduce their footprints. On the other hand, the protestors took to the internet to organize the occupation of new sites. Simultaneously, the police employed massive arrest and detaining of the protesters trying to leave the airport and those who arrived by declaring them a threat to national security. As much as the city's security forces tried hard to contain the movement's activities through nonviolent means, they were stretched thin, and sometimes, they could act violently out of desperation. Further, the fact that the protestors operated from three different parts of the city was a depressing factor. The situation was made worse when the police were required to protect the Umbrella Revolution protests from counter-protestors, although they eventually turned against them and started pushing them back. Eventually, when the movement leaders realized excess use of non-lethal weapons and violence, they called on the protesters to disperse and sought alternative means to demand their rights (Tharoor and Wan, 2014).

COPING CAPACITY

The organization of the Hong Kong Police Force enables it to respond to different situations variedly. Amongst its ranks, there are around 28,500 to 38,000 members (Pomfret, 2014; Los Angeles Times, 2014), and that includes the auxiliary police force specializing in emergencies and the marine units whose main role is to patrol the Hong Kong waterways and Islands. These forces are not linked to the mainland forces. They operate independently from mainland China's security forces. They recruit, train, and deploy their members internally (Hong Kong Police Force). They are usually armed with pepper spray, a baton, and a sidearm. However, specialized units may carry heavier weapons depending on the situation they are responding to. Also, the Police Force is equipped with a variety of patrol vehicles, such as the heavily armored vehicles that are equipped with

riot gear (Pomfret, 2014). The fire unit response unit operates under the Hong Kong Fire Services Department. It has almost 10,000 uniformed members and hundreds of civilian members. The unit is equipped with modern equipment and has a high approval rating among Hong Kongers. It operates independently from the mainland fire response unit. Standing at over 90% approval rating, the Hong Kong Fire Services Department Forces maintain a higher approval rating than the PLA forces.

EXPECTANCY BENCHMARK

The expectation of the Hong Kongers toward their police forces has been positive due to their long history of professionalism, and most importantly, the low crime rate. Even though the Umbrella Revolution protests' pressure highly challenged it, the Police Force is highly regarded among Asia's police forces. Part of this reputation is earned from the Force's stand against corruption. Although corruption cases did exist from the British era, the situation has changed, and the force enjoys a high perception of professionalism and skills.

Based on this reputation, the protestors did not expect any form of violent encounters with the police. They expected a relatively peaceful protest, and they even tried to cement the actions, underpinning their need for a nonviolent interaction with the police. During the protests, some volunteer protestors joined the police in clearing the streets and sorting the litter for recycling. On the blocked road, protestors created a way for ambulances and emergency vehicles. The protestors believed that the police did not have enough forces to close down districts where they protested. Further, even though the protestors were aware that the situation could escalate to unmanageable proportions, they least expected any form of use of violent force from the police. The thought that both the police and them (protestors) and ultimately, students' leaders would travel to Beijing for negotiation (Kuo, 2014).

However, almost everything did not work according to their expectations. For the first time since 2005 (Los Angeles Times, 2014), the police unleashed tear gas on the protestors. But the protesters did not change their expectations. They still held a view that everything would turn out peaceful despite the scale of the protests. They also expected that if Beijing got involved, the rule of law could be abused, and the security forces would be overshadowed. It has also been recorded that some of the protestors were "worried that the security forces might become the Gong An," which is a reference to a Public Security Bureau, which is a mainland

China security force that the people fear because it enjoys almost unfettered powers. Police brutality increased toward the end of the protests. They resulted in using pepper and spray without issuing any warnings. Emotions shot high as the police escalated to beatings and arrests. Finally, some protest organizers advised the protestors to retreat due to increased violence. As protestors retreated, they dispersed, and the protests came to an end.

Even after the brutality, the public opinion toward the Hong Kong security forces at the end of the protests. In fact, it had shifted by a negligible percentage but remained at a steady 61-62% rating. Little was known about the PAP's involvement in the protests, and therefore, we cannot make any conclusive statement on it.

Security - Non-Military Forces

Dimensions	Evaluation
Adaptive Capacity	Positive
Coping Capacity	Positive
Expectancy Criterion	Positive

VIOLENCE POTENTIAL

To evaluate Hong Kong's violence potential, we focus on the protests, the security forces, and the protestors and analyze how the triads interacted during the Umbrella Revolution protests.

ADAPTIVE CAPACITY

During the entire course of the protests, the Hong Kong security forces and the protestors adjusted to fit into the protests' atmosphere. At one point, the security forces were passive observers of the

Fig 6.5: Pro-democracy protesters (right) protect a barricade from rival protest groups (left) in the Mong Kok district. Source: AFP/Philippe Lopez

protests. At some point, they encountered the protestors aggressively, pushed them back, routed, and injured some while arresting others. The same police at some point, protecting the demonstrators when the Umbrella Revolution met with counter-protestors who were supporting the new rule by the Beijing government. Even so, there remained some collaboration between the security forces, the protest, and the protestors. As for the protestors, they sometimes shouted and jeered at the police, while on other occasions, they engaged them in a friendly manner. Other protestors, having been unsatisfied with the direction the movement was moving, resulted in violent and aggressive means to pass their message. Some counter protestors exercised extreme violence directing the brutality towards students, journalists, and other groups of protestors (BBC News, 2014) . Despite all these, security was heightened, and the triad existed without escalating to further chaos and violence apart from the witnessed levels. Therefore, this shows high levels of the city's adaptive capacity.

COPING CAPACITY

Although Hong Kong has witnessed high levels of social unrest in its recent history, it remains one of the safest cities globally, measuring from the levels of crime rates. Gun owners are restricted, and ownership requires registration – a process that few people can manage. Nonetheless, there exist over 260,000 guns in the hands of private citizens. Since the handover, the territory has experienced major and minor protests that have left some dead and some injuries.

In the 1992's protests over the anti-subversion of Article 23 and its enactment into Basic Law, 21 people died. In July 2003, over 500,000 people took to the street to protest the leadership of Tung Chee-hwa. For the first time since the founding of the People's Republic of China, the Beijing government backed down on popular pressure and removed Tung Chee-hwa from the seat (Lague, 2014). On September 8, 2012, tens of thousands of Hong Kongers protested the introduction of Chinese patriotism as a mandatory course in Hong Kong Schools. A month before the Umbrella Revolution, over 500,000 people took to the streets to support democracy, while counter-protestors also joined in protestation. Afterward, students boycott classes on September 22, 2014, on the 27th of the same month, the march to government offices began. Occupy Central joined the protest on September 28. With over 80,000 people in attendance, the number faded over the weekdays and swelled over the weekends (Pomfret, 2014). On October 3, 2014, anti-Occupy violence

broke out. The pro-democracy supporters and the groups supporting Beijing's new rule confronted each other at Causeway Bay, Mongkok, and Kowloon.

Hong Kong's security has been relatively high, especially in the 1960s and 1970s when local gangs' activities diminished. After the city was handed over to China, much of the traditional, infamous triad violence and open criminality diminished. The gang members transitioned into secretive black-market activities, and others joined legit businesses. Although some still exit as thug-for-hire, their numbers are minimal. The city has 29 correctional facilities, all of which can accommodate up to 8,400 people in total. There are 24 correctional institutions within the facilities, two custodial wards of public hospitals, and halfway houses. Prisons exist in two levels; minimum-security prisons, equipped with one fence, and medium-security prisons, equipped with double fences. Criminal activities have reduced significantly over the years. In 2004, the recidivism rate stood at 36.5%, but this rate reduced remarkably to 27.1% in 2013. Generally, the availability of relative security facilities that can contain criminality in the city is why Hong Kong is experiencing a minor overall potential violence in prison systems.

EXPECTANCY BENCHMARKS

When the Umbrella Revolution protests were retreating and eventually dispersing, their numbers had grown to a sizable population of dissenters that could have easily scaled up to more violence, tension, and an upward spiral of participation. Cases of police-protest confrontation could easily increase, and so could the cases of protests and counter-protestors. Nonetheless, when the situation was almost getting violent and out of control, the protester valued Hong Kong's survival. The protestors and the security forces exhibited their respective sense of self, and in the end, the city maintained its signature peaceful image.

Security - Violence Potential

Dimensions	Evaluation
Adaptive Capacity	Positive
Coping Capacity	Positive
Expectancy Criterion	Positive

Securing the Urban Environment

The security aspect analysis in Hong Kong presents important factors to consider for future security in modern, densely populated urban environments. Hong Kong is one of the most densely populated urban environments globally,

with approximately 7 million people in a 426 square mile area. Apart from people, the city is popular for its 1,440 skyscrapers densely packed together to accommodate such a huge population in a small space. The streets of the city are always congested. For this reason, the PLA garrison troops navigate around the city in armored vehicles mounted with lighter weapons such as machine guns to manage going through the narrowest and most difficult-to-pass streets. Additionally, the city contains a mix of the old WWII tunnels, subway systems, mines, flood plains, and sewerage treatment facilities. As the city expands, experts are now considering expansion to underground locations (South China Morning Post, 2016).

The Hong Kong's former Prince of Wales Barracks building, now known as Central Barracks, represents the unique structure considering its design and the defensive nature it creates. The building resembles an upside-down bottle. Therefore, the lower part of the building narrows intentionally, increasing the building's defensive capabilities from attack. It creates an anonymity perception to adversarial forces but the military personnel inside, and they get a good vision of the target's location (Skyscraper). It, therefore, represents an impeccable response strategy to the large-scale or violent outbreak since, with such architecture, one can easily control the situation. In cases of lawlessness and desperation, the city will require unimaginably large amounts of resources and personnel; it is the reason why urban

Fig 6.6: The Image of the Central Barracks.

environments should consider planning the city in a way that allows increased defensive abilities.

The Hong Kong city security personnel have so far been able to contain various major protests without necessarily requesting aid from the military. This can be attributed to the general layout, as well as the geographical location of the city. But on the other hand, the possibility of future lethal protests cannot be ruled out given the city's congestion. In such a protest, the fact that buildings and people are packed together, creating a dispersion difficulty, could easily materialize into a deteriorating situation. The blockage of streets, subways, train stations, among other areas that allow the supply of essential services and goods, can easily destabilize the city.

Security - In General

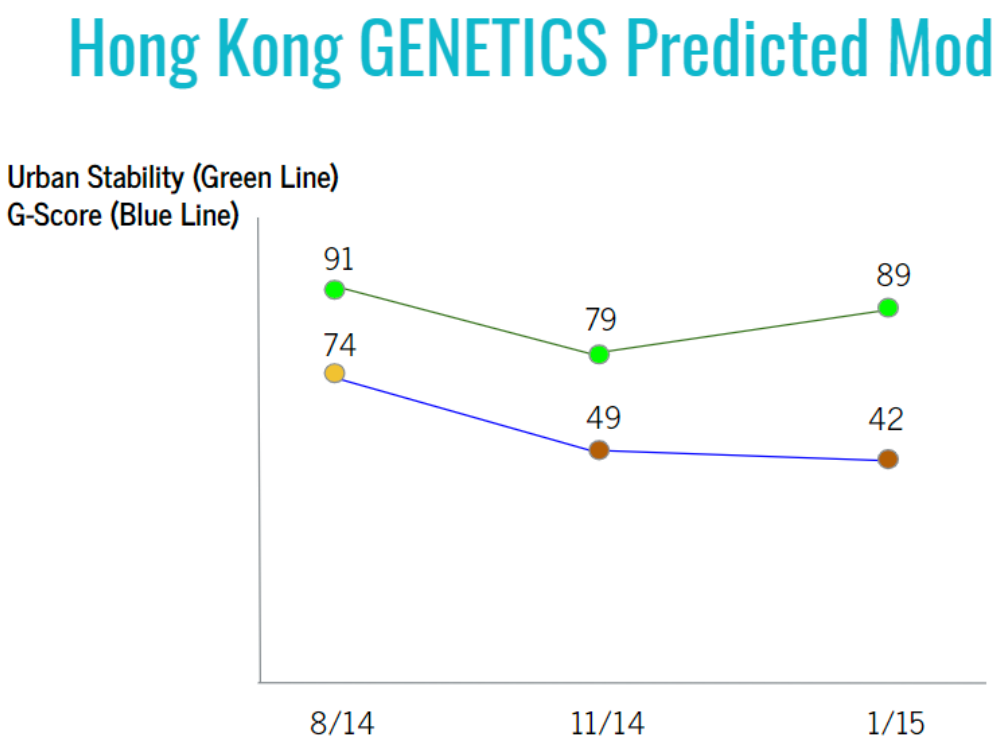
Dimensions	Evaluation
Adaptive Capacity	Positive
Coping Capacity	Positive
Expectancy Criterion	Positive

CONCLUSION

Considering the dimension of focus in this case study, the adaptive capacity, coping capacity, and expectation benchmark, we concluded that Hong Kong presents significant factors for future consideration. First, not all stability factors contribute to a city's stability, nor do all of them contribute as stressors. While some play a limited role in a given context, some actively contribute to the creation of the situation. Second, we found out that many factors give an overall neutral impact because the same criteria indicated opposite conclusions. From this, we establish that many cities suffer from the complexity of the crisis faced by Hong Kong. It is, therefore, necessary that the policymaker and decision-makers be aware of this situation and consider them when studying a city in the future.

HONG KONG CASE PREDICTED MODEL

Informed by this in depth analysis, we endeavored to distill the complex information conveyed above in an easily consumable numerical format. While the GENETICS model is incomplete, in the sense it is not able to produce automated results quite yet, we still sought to reason through G-sum model and Urban Stability scores. These scores were determined contextually by our case analysts, based on comparisons with other urban centers. Through this process, we offer predicted values for three different periods of time during the umbrella protests. While we may expect a completed model to produce different numerical results, the trend is easily observable and would be corroborated. Stability in Hong Kong started exceptionally high (91), but protests surrounding our governmental "G" variable catalyzed a tipping point into a lower level of stability (79). Although the government did not improve post-protests, stability recovered to a pre-crisis level. How is this possible? It is very likely that changes to other variables we haven't deep dived yet, whether they be Security or Economic factors, improved enough to off-set the delta in government.



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