

Virtual Pakistan 2013
An Agent-Based Modeling Analysis

By: Quratul-Ann Malik

Dr. Ian Lustick, Advisor

A thesis submitted in partial fulfillment of the requirement for the Degree of Bachelor of Arts in
Political Science with Distinction

University of Pennsylvania
Philadelphia, PA
April 1, 2013

Abstract

This thesis suggests that agent-based modeling provides an effective way to understand and analyze the internal political dynamics of Pakistan. The first section describes Pakistan's current situation and introduces a study published by the Council on Foreign Relations (CFR) outlining five possible futures the nation could experience. After stating the five futures, I hypothesize that agent-based modeling could enhance this study and provide arguments that social scientists use to justify this quantitative approach. The next portion of the thesis intricately describes all aspects of the model-building process. The experimentation process and metrics are then discussed and finally, the experiment results are compared with the CFR study on Pakistan. The thesis concludes that agent-based modeling provides a complementary, systematic and logical way to examine nations' political futures. Rather than forecasting, agent-based models provide researchers with a palette of possible trajectories.

ACKNOWLEDGEMENTS

It is my honor to thank my research advisor, Professor Ian Lustick, for inspiring me to pursue agent-based modeling, spending hours discussing ideas with me, carefully reading all of my papers, and providing me with the resources to pursue my dream of modeling Pakistan. I am continuously inspired by his passion for agent-based modeling and cannot imagine a better research advisor.

I am also thankful for Miguel Garces and Brandon Alcorn who made time to teach me the computer science required to create an agent-based model using PS-I, discussed model-building decisions with me and answered my questions at all hours of the day. Miguel Garces also taught me how to use the statistical analysis package RStudio specifically for this thesis. This thesis would not be possible without their generous time and help every Friday since August 2011.

In addition, I would like to thank Professor Eileen Doherty-Sil, Dr. Dani Miodownik, Dr. William Fitts, Dr. Matthew Tubin, and Matthew Reichert for their advice and suggestions.

I am especially thankful for my parents' support throughout this project. In 2008, I originally mentioned the idea of modeling political phenomena to my father. He encouraged me to pursue this interest and without him, I would never have completed this project. I am also thankful for my mother whose words of encouragement have made the toughest days easier.

Table of Contents

<u>I. Introduction</u>	7
<u>2. Possible Futures of Pakistan</u>	9
<u>3. Agent based Modeling and Virtualizations</u>	12
3.1 Qualitative Modeling - Expert Panels	13
3.2 Defining Agent-based Modeling	14
3.3 Agent-Based Modeling Evolution.....	14
3.4 Benefits of Agent-Based Modeling	15
3.5 Limitations of Agent-Based Modeling.....	19
<u>4. Understanding the Internal Political Dynamics of Pakistan</u>	20
<u>4.1 The Dynamic Political Hierarchy (DPH)</u>	21
<u>4.2 Identities</u>	24
4.2.1 Ethnolinguistic identities – Punjabi, Sindhi, Pashtun, Balochi	24
4.2.1.1 Punjabi	25
4.2.1.2 Sindhi	25
4.2.1.3 Balochi	25
4.2.1.4 Pashtun.....	26
4.2.1.5 Muhajir, Afghani, Kashmiri	27
4.2.1.6 Saraiki	27
4.2.1.7 Urdu	27
4.2.2 Religious Identities – Sunni Muslim, Shia Muslim.....	28
4.2.2.1 Sunni Muslim	28
4.2.2.2 Shia Muslim.....	28
4.2.2.3 Other religious minorities: Christian, Qadiani, Hindu, and Scheduled Caste	29
4.2.3 Political Party Identities – PPP, PML-N	29
4.2.3.1 PPP.....	29
4.2.3.2 PML-N.....	30
4.2.3.3 Other Political Parties	30
4.2.4 Societal Identities – state, nationalism, globalism, military,	31
4.2.4.1 State	31
4.2.4.2 Nationalist.....	31

4.2.4.3 Globalization	31
4.2.4.4 Military	32
4.2.4.5 Jihadi identity	32
4.2.4.6 Criminal/Corrupt	33
4.2.5 Socioeconomic Identities.....	33
4.2.5.1 Poor.....	33
4.2.5.2 Middle Class	34
4.2.5.3 Wealthy/Upper Class	34
<u>4.3 Elite Networks and Influential Agents</u>	<u>34</u>
4.3.1 State Elites	36
4.3.2 Military Elites	39
4.3.3 Business Elites	40
4.3.4 Religious Elites	41
<u>4.4 Temporal and Spatial Elements.....</u>	<u>42</u>
4.4.1 Geographical Landscape.....	42
4.4.1.1 Provinces, Administrative Divisions and Administrative Districts.....	43
4.4.1.2 Settlement Points	43
4.4.2 Temporal Elements.....	43
<u>4.5 Generic Political Model</u>	<u>43</u>
4.5.1 GPM: Agent Attributes.....	44
4.5.2 GPM: Agent Classes.....	45
4.5.3 GPM: Field Commands	45
4.5.4 GPM: Parameters.....	46
4.5.5 GPM: Rules	47
4.5.6 GPM: Views	47
4.5.7 GPM: Statistics	48
<u>5. Experimenting with Operationalization</u>	<u>48</u>
5.1 A State Adrift	51
5.2 A Military Coup	53
5.3 An Islamist Government	54
5.4 A Moderate Government.....	55

5.5 A Collapsed State	56
<u>6. Analyzing the Results</u>	58
6.1 Results: A State Adrift	62
6.2 Results: A Military Coup	67
6.3 Results: An Islamist State	70
6.4 Results: The Moderate State	72
6.5: Results: Collapsed State.....	75
<u>7. Conclusion</u>	83
References.....	88
<u>Appendix A</u>	93
<u>Appendix B</u>	99
<u>Appendix C</u>	103
<u>Appendix D – ‘PakistanethnicregionCartogram.scp’</u>	105
<u>Appendix E – ‘PakistanmajorcitiesCartogram.scp’</u>	105
<u>Appendix F – ‘PakistanwithpopulationCartogram.scp’</u>	105
<u>Appendix G – ‘PakistanwithpopulationCartogram2.scp’</u>	106
<u>Appendix H – ‘PakistanwithpopulationCartogram3.scp’</u>	107

I. Introduction

Pakistan is among the most complex nations in the world. The government lacks stability and has oscillated between military regimes and democratic civilian governments since its creation in 1947. In the past 10 years, Pakistan has experienced two different types of government structures and become more volatile and dangerous than ever before. The political turmoil within Pakistan hinders the country from progressing socially, economically or in any other capacity. To make matters worse, the nation faces other issues such as corruption, overpopulation, energy and water crises, a low per capita income and violence from terrorist and drone attacks.

Despite its numerous challenges, Pakistan has held together as a nation and remains largely functional. On March 16, 2013, Pakistan's civilian government completed its entire five-year term without a military intervention for the first time in its history. Such accomplishments raise the question - will Pakistan continue on this path towards democracy or will the country veer towards a different trajectory? Answering this question is extremely important as the nation possesses nuclear weapons, maintains a weak civilian government and has terrorist organizations within its borders. All of these concerns suggest that an examination of the country's internal affairs may provide a better understanding of possible trajectories.

Founded after negotiations with the British Empire, Pakistan was created as a nation for Muslims residing within the Indian subcontinent. For decades after its formation, Pakistan lacked a constitution and strong political parties to create a precedent of civilian governance. Unable to recover from this unsound beginning, the country has experienced three military coups in its 65-year history. To this day, Pakistan's contentious relationship between civilian and military institutions has distracted officials from focusing on economic growth, education, healthcare

reform and other nation-building efforts. In addition to these issues, Pakistan remains enemies with its neighbor India. The consistent fear of going to war with India has encouraged the government to spend most of its budget on the military. All of these different but troublesome issues contribute to Pakistan's current volatile state. Pakistan, therefore, is one of the most difficult countries to comprehend. However, understanding Pakistan remains an important issue not only for Pakistanis, but also for the international community.

In recent decades, Pakistan has become increasingly vital to the United States. Although they remain allies, the two countries share a mutual distrust. The tension between the two nations has reached an all time high in the past three years. Drone strikes by the United States targeting terrorists in Pakistan's Federally Administered Tribal Areas have angered the people and contributed to the decline of public opinion on the U.S.¹ Terrorist organizations continue to retaliate by suicide bombing within Pakistan, targeting prominent Pakistani officials and people associated with the United States. Furthermore, the relationship recently worsened with consecutive contentious events including an increase in such drone strikes, the accidental killing of Pakistani soldiers by the U.S. military in a cross-border skirmish and secretly invading the country to capture Osama Bin Laden. These tense events have demonstrated the critical need to study and understand Pakistan.

Although many scholars have attempted to study the country and predict outcomes using qualitative methods, this thesis attempts to understand and analyze Pakistan's future by utilizing agent-based modeling.

¹ Out of Sight, Out of Mind: a Visualization of Drone Strikes in Pakistan since 2004. (2013). Retrieved March 21, 2013, from <http://drones.pitchinteractive.com>

2. Possible Futures of Pakistan

Pakistan's future remains uncertain and many scholars have speculated possible trajectories. These trajectories can be seen in the Council on Foreign Relations' study titled, "Crisis Guide: Pakistan." This interactive website outlines five possible futures Pakistan could experience in the coming decades. These futures, titled "A State Adrift," "An Authoritarian State," "An Islamist State," "A Moderate State" and "A Collapsed State," reflect the general scholarship available on Pakistan's prospects.

The first scenario Pakistan could experience, "A State Adrift," refers to the possibility that Pakistan will continue on its current path of political instability with broken political parties lacking ideological stances, weak civilian institutions penetrable by the military, corruption by officials and no nation building efforts. Such a scenario also involves no single institution dominating the nation. Author Kanti Bajpai adds to this by saying that this future is likely if separatists groups like those in Balochistan and Islamist organizations continue to lack strength in number, power and popular opinion to overcome the predominantly Punjabi military attempting to hold the country together. Pakistan "muddling through" may also include the government continuously "firefighting" issues as they arise rather than solving problems in the nation with a long-term strategy.²

A second scenario Pakistan may experience is a military coup. While history suggests that this outcome is possible, authors Aqil Shah, Kanti Bajpai, Shaukat Qadir, Stephen Cohen and others all believe this fate appears unlikely in the immediate future because of General Musharraf's long and unsuccessful term as President of Pakistan. However, a military government could still occur in a few ways. If political parties "cross certain red lines" that are

² Qadir, S. (2011). Still an Uncertain Future. In S. Cohen (Author), *The Future of Pakistan* (pp. 199-214). Washington, DC: Brookings Institute.

typically reserved for the military, this could anger military elites and lead them to retaliate. This future could also occur if internal violence becomes unbearable and the nation appears on the verge of collapse.

Another scenario that Pakistan could experience is an Islamist government rising to power. Authors Bruce Riedel, Ahmed Rashid and Anatol Lieven cite this as an unlikely, but possible scenario. They imagine that this scenario could play out in three different ways. First, Pakistan could experience a military take over by a general holding similar worldviews to those of General Zia-ul-Haq who promoted Islamicization between 1980 and 1988. An extremist general may encourage army recruits from the same villages as the people in militant groups such as Lakshar-e-Tayiba.³ An Islamist government could also rise to power from an insurgent group victory. Such a scenario would be extremely difficult, and would require an increase of public support for the Taliban.⁴ With the increase of terrorism in the past 7 years, such support appears unlikely. A third scenario would involve an Arab Spring-like situation taken over by madrasa cohorts and well-armed militias.⁵ All three authors write that this outcome is unlikely, but still in the realm of possible futures.

A fourth scenario referenced by many authors is a best-case scenario government in which a moderate and effective leader comes to power. Scholars write that this scenario could occur if the person serving as the Prime Minister asserts themselves to solve problems of national security, food shortages, inflation, health care, education, job opportunities and much more. It may also require the Prime Minister to incorporate parts of the tribal areas into Pakistan in an effort to reduce the amount of terrorism. Another way this scenario could take place is if

³ *Deadly Embrace: Pakistan, America, and the Future of the Global Jihad*. (2011). Washington, DC: Brookings Institution.

⁴ Rashid, A. (2012). *Pakistan on the Brink: The Future of America, Pakistan, and Afghanistan*. New York, NY: Penguin Group.

⁵ Ibid, 203

political parties begin forming ideological platforms and institutions that allow for their survival beyond a family fiefdom. All of these political changes would need to be accompanied by some type of growth in the urban middle class interested in maintaining democracy and the military interested in remaining subordinate.⁶

Another outcome scholars include is a collapsed state. Scholars interpret a collapsed state as one in which the country can no longer remain a single entity and divides ethnically or religiously. Although this scenario remains unlikely, there are a few ways they envision such an outcome unfolding. If there was no leader who could unite the country, ethnic and religious divides may continue to grow.⁷ These divides may eventually evolve into an increase of violence or even civil war. This scenario also involves a weak Punjab province that cannot prevent a break up. Punjab is the most dominant province and without it, the country would be unable to remain together. Another way this future could occur is with the assistance of some outside nation.⁸ For example, in 1971, India successfully assisted a group of Pakistanis secede from the central government to form their own nation, Bangladesh. However, this future appears less likely than any of the others. Anatol Lieven writes,

“with the exception of some of the Baloch who think that they would do well on the strengths of their gas and mineral reserves, very few political or intellectual groups in Pakistan and Pakistan’s provinces actually want to break the country up whether because they are genuinely attached to it (in the army, the bureaucracy and much of Punjab); because they hope to take it over and use it as a base for a wider programme (the Islamists); because they are afraid of Indian domination (Punjabis); because they are afraid that Pakistan’s break up would lead to a dreadful civil war with other ethnicities (The Sindhis and the Mohajirs), and even the Pathans, since the Hindko speaking minority in NWFP is strongly opposed to Pathan nationalism); or simply because the alternative looks so much worse (the Pathans, when they look across the border into Afghanistan). So one of the biggest factors holding Pakistan together is fear.”⁹

⁶ Shah, 205

⁷ Bajpai, Kanti. (2011). Pakistan’s Future: Muddle Along. In S. Cohen (Author), *The Future of Pakistan* (pp. 199-214). Washington, DC: Brookings Institute.

⁸ Ibid, 73

⁹ Lieven, A. (2011). *Pakistan: A Hard Country*. New York, NY: PublicAffairs.

This quote suggests that all groups vying for power in Pakistan are only doing so because they see opportunity in taking over the country as a whole. These people are less interested in a fragmented Pakistan and thus will try to keep the nation together.

These five scenarios are summed up in the Council on Foreign Relations' Crisis Guide: Pakistan study. The purpose of this thesis is to construct an agent-based model of Pakistan, titled "Virtual Pakistan 2013," which closely examines the five proposed futures. The simulation examines the frequency of the proposed outcomes and discusses other possible trajectories of Pakistan that they did not include. The next section discusses the value of agent-based modeling, then explains the model building processes and shares results from running the simulation. I hypothesize that Virtual Pakistan will provide a more useful way of examining the five possible futures and will exhibit more scenarios than those five listed. The following sections will test this hypothesis by explaining the model building process and comparing the experiment and results with those suggested by the CFR.

3. Agent based Modeling and Virtualizations

Policymakers and academics constantly strive to discover the unknown. Mathematics opens the door for physical scientists to find the unknowns of physics, chemistry and biology. Similarly, political scientists strive to discover unknowns such as the likelihood of regime change, political identity dominance and economic instability. However, for such complex questions, mathematics remains unable to provide answers. Many political scientists have attempted to predict and forecast political phenomena through qualitative methods such as expert panels, while others have attempted to predict political phenomena through quantitative techniques including statistical modeling, rational choice theory, game theory and agent-based

modeling. This section examines the pros and cons of the two types of modeling discussed in the paper: qualitative mental models as seen in the CFR report and agent-based models.

3.1 Qualitative Modeling - Expert Panels

Policymakers rely on expert panels when predicting political futures of nations. The Council on Foreign Relations' report on Pakistan provides an example of such a panel. It serves as a platform on which multiple South Asia scholars discuss their thoughts on Pakistan's political future. Ian Lustick's "From Theory to Simulation" explains expert-panels' rise to prominence in the 1970s when policymakers predicted possible consequences of the 1973 embargo.¹⁰ Many academics continue to favor this modeling method, as they believe it more accurately accounts for complex human behavior and regional culture than quantitative modeling. Area experts often consider nuances in a region's political culture and can imagine scenarios in great levels of detail. From a proponent's perspective, quantitative modeling, in an attempt to simplify complicated interactions, misses important unique qualitative concepts in the process.

Despite the benefits of such mental models, there are many reasons why this method is not used in this paper. First, expert-panels are often subject to human emotions and biases. Scholars who understand the political and social fabric of a nation could unknowingly lean towards one political future because of their own internal biases. Philip Tetlock's paper discusses that another flaw of qualitative modeling is that explanations with more detail or better rhetoric may appear more convincing.¹¹ These unchecked issues may cause problems in examining a possible future of Pakistan. Qualitative models are also not conducive to examining rare or

¹⁰ Lustick, I., Alcorn, B., Garcés, M., & Ruvinsky, A. (2010). From Theory to Simulation: The Dynamic Political Hierarchy in Country Virtualization Models. *Annual Meeting of the American Political Science Association*. Retrieved from <http://lustickconsulting.com/data/Theory%20to%20Simulation%20APSA%202010.pdf>, pg1

¹¹ Tetlock, P. (2005). *Expert Political Judgement: How Good Is It?* Princeton, NJ: Princeton University Press.

unusual futures. Because area-experts are human, they are limited in their ability to think of all possible trajectories a nation could experience. A computer model, which accounts for randomness in the real world, generates hundreds or thousands of additional futures that a human expert may accidentally neglect to consider. The CFR's report, as will be discussed later in the paper, provides five unique and interesting possible futures but leaves out other possible outcomes and provides no justification for why these five should be considered more plausible than other scenarios.

3.2 Defining Agent-based Modeling

Agent-based models consist of autonomous units, or agents, whose micro interactions impact macro behavior. "Rules," based on political theory, govern these micro interactions. For example, if the theory claims that groups alienated from the government will protest, the researcher creates a rule calculating which groups lack connection to the government and increases their propensity to act violently. Agent-based simulations, when analyzing political, social or economic situations, incorporate census data, survey data and qualitative information to combine elements of the real world. Applying rules and data to the agents, agent-based models produce different trajectories of possible futures.

3.3 Agent-Based Modeling Evolution

Agent-based models gained popularity after John Conway's "Game of Life" model, in which four simple rules controlled the behavior of autonomous actors or "agents." In his model, agents could be in one of two states of being – alive or dead. After creating and simulating "The Game of Life," he concluded that the model evolved differently depending on the initial landscape. Agent-based modeling builds upon his initial idea as it uses rules to govern an agent's state of being. These rules can be complicated or simple depending on the problem at hand.

After John Conway's initial model, Robert Axelrod, Lars Cederman, Robert Axtell, Josh Epstein and other scholars have built upon Conway's work and used agent-based modeling to answer more complex questions in the social sciences and study patterns of emergence. Ian Lustick, specifically, has used agent-based modeling in an innovative way to study ethnicity and political identity.¹² The agent-based model presented in this thesis, Virtual Pakistan 2013, uses Lustick's assumptions that agent-based modeling can be utilized to examine questions of ethnicity and collective political identity.

3.4 Benefits of Agent-Based Modeling

Agent-based models can effectively capture the political complexities of a nation like Pakistan for multiple reasons. Unlike qualitative models, the agent-based model can examine both extremely simple and complex political phenomena. They also provide political researchers with the ability to account for bounded rationality, examine internal emergence, use systematic approaches when thinking about subjective matters, test "what if " and hypothetical scenarios, allow visualizations of patterns in a spatial realm, and maintain a repeatable and recoverable process. Despite these benefits, agent-based models also have some limitations. The main limitation is that computer models are only as good as the data that is available and are full of unchecked assumptions. Another limitation of agent-based models is the lack of standardized modeling approaches.

Agent-based models have the ability to capture both complex and simple behavior. Miller and Page refer to the capability as their "flexibility and precision." These simulations have the flexibility to incorporate rules in the computer coding that capture all of the various complexities

¹² Lustick, I. (2000). Agent-based Modeling of Collective Identity: Testing Constructivist Theory. *Journal of Artificial Societies and Social Simulation*, 3(1). <http://jasss.soc.surrey.ac.uk/3/1/1.html>

of the world, while still maintaining a high degree of precision.¹³ They have the capacity to represent both behavioral and environmental assumption in the model with little effort. Similarly, models can capture political, economic and social phenomena. In other words, models are extremely versatile. Thomas Berger, when creating a model on the technological impact on agriculture, chose agent-based modeling because he could include both the technical and financial constraints in the rules.¹⁴ Ian Lustick and Dani Miodownik also discuss the wide spectrum of agent-based models that can be created through modeling platform, PS-I.¹⁵ The three kinds of models referenced are titled Abstractions, Ensembles and Virtualizations. Abstract agent-based models test the simple interactions between agents by altering one or two parameters at a time, ensemble models test abstract theories while incorporating elements of the real world, and Virtualizations attempt to model the specific political conditions occurring in a particular place and time. As will be explained below in the Dynamic Political Hierarchy section, Virtual Pakistan is a Virtualization that combines political, psychological and evolutionary understandings of the world.

Agent-based models also store and usefully incorporate large amounts of data. Berger writes that agent-based models allow users to “pragmatically treat the availability of data in transition and in developing country.”¹⁶ Virtual Pakistan, for example, uses census data, survey data and interviews to create and explain relationships between the multiple ethnic, religious, socio-economic and political party identities.

¹³ Miller, John H. (2007) *Complex Adaptive Systems: An Introduction to Computational Models of Social Life*. Princeton: Princeton UP.

¹⁴ Berger, Thomas. "Agent-Based Spatial Models Applied to Agriculture: a Simulation Tool for Technology Diffusion, Resource Use Changes and Policy Analysis." *Agricultural Economics* 25 (2001): 245-60. <http://vserver1.cscs.lsa.umich.edu/~rlr/CSCS530/uploads/Main/Berger-ABM-Innovation-Diffusion-Agriculture.pdf>.

¹⁵ Lustick, I., & Miodownik, D. (2009). *Abstractions, Ensembles, and Virtualizations: Simplicity and Complexity in Agent-Based Modeling*. *Comparative Politics*, 41, 223-244.

¹⁶ Berger, 247

Agent-based models also allow for bounded rationality. Unlike agent-based models, rational choice models assumed that all agents always acted rationally. In other words, in rational choice models, all agents behaved the exact same way. Because people have different functions and levels of importance in society, these models could not reflect the real world. Agent-based models lack this problem as agents can have access to different information to make decisions and have different computing powers.¹⁷ Epstein explores bounded rationality in his model “Sugarscape” as he restricts the opportunities that different agents perceive depending on their set of attributes. These attributes include their vision, metabolism and more. Thus, the researcher has the ability to ensure that each agent behaves differently. Virtual Pakistan takes advantage of this capacity by maintaining both elite agents and basic agents. Elite agents receive information and adjust based on other assigned elites regardless of those agents’ geospatial locations. However, basic agents only receive information and adjust their identity repertoire based on those agents directly next to them.

Complex and emergent phenomena are apparent in agent-based models. Unlike other types of models such as rational choice or game theory models that eventually end in equilibrium, agent-based models can continue forever in an unstable or chaotic state. Johnson writes that this occurs because the micro interactions often led to an unexpected aggregate outcome. Miller and Page add that for the natural sciences, reaching equilibrium signifies the death of a system.¹⁸ In the real world, social systems do not die out and thus this equilibrium and chaos is necessary. Agent-based models allow complex phenomena to emerge in the model through a bottom-up process.¹⁹

¹⁷ Epstein, Joshua. "Agent-Based Computer Models and Generative Social Science." *John Wiley & Sons, Inc.* 4 (1995): 41-60. Pg. 2

¹⁸ Miller & Page, 83

¹⁹ Epstein, 42

Systematic and logical rules are required to run an agent-based model.²⁰ This is the major difference between qualitative models and agent-based models. Qualitative models, especially in fields such as political science, are susceptible to scholars' internal biases. Agent-based models prevent this occurrence, as computer models will not accept rules that are not logical. While qualitative models could include specific and rigorous rules to make predictions, there is no requirement.

Agent-based models serve as a platform to test hypothetical “what-if” scenarios for the purpose of refining the model. Hugh Gusterson mentions this benefit of agent-based modeling as a rationale for testing nuclear simulations.²¹ Agent-based models can examine what if scenarios because the parameters allow for variation. All experiments are also repeatable and recoverable. As Miller and Page state, simulations allow the researcher to “rerun the tape.”²² Laura McNamara also discusses the benefits of computer simulation of nuclear weapons in her paper as she writes that rerunning the experiments forced experimenters “to characterize the device under development and refine theoretical models, defining new questions, and – as necessary – using the data to prepare for further tests.”²³ Thus, running “what if scenarios” and multiple tests improved the quality of the model as will be seen in the experimentation section of this paper.

Agent-based modeling can also account for geographical elements of a model. Berger writes that for his agricultural model, ignoring spatial dynamics may drastically impact the outcome of his model. He writes, “in rural areas, where many farms with a high marginal productivity attempt to expand their acreage, this can lead to excessive land prices that may even

²⁰ Laver, M., & Sergenti, E. (2012). *Party Competition: An Agent-based Model*. Princeton, NJ: Princeton University Press; Miller & Page, 80

²¹ Gusterson, H. (2001). The Virtual Nuclear Weapons Laboratory. *Wiley-Blackwell*, 28(2), 417-437.

²² Miller and Page, 86

²³ McNamara, Laura Agnes. (2001). "Ways of Knowing about Weapons: The Cold War's End at the Los Alamos National Laboratory." Diss. University of New Mexico, http://www.fas.org/programs/ssp/nukes/new_nuclear_weapons/cwendlosalamos.pdf

prevent the realization of economies of scale. Ignoring these spatial dynamics by assuming perfect land allocation among farms is not always an adequate representation of reality.”²⁴ The capacity for geographical considerations also matters in Virtual Pakistan. As discussed in the paper, Global Information Systems (GIS) is used to map the provinces and divisions in the agent-based model. The provinces and divisions matter in Pakistan because certain groups, such as ethnicity and nationalist identity are seeded based on this specific data. The ability to account for geospatial factors, therefore, contributes to agent-based models’ value.

3.5 Limitations of Agent-Based Modeling

Although there are many benefits to using agent-based modeling, there are also many limitations. First, agent based models are only as valuable as the data that a person enters. While Virtual Pakistan lacks perfect data, it includes the most granular information available for each identity. In most cases, “granular” refers to the provincial level data or the best data available whether that is census data or information from Pakistan experts.

Another limitation mentioned by Paul Johnson is that agent-based models are full of unchecked assumptions.²⁵ Although the unchecked assumptions in Virtual Pakistan are a limitation, they are still superior to using qualitative mental models. They require the modeler to consider questions that qualitative modelers are not considering. For example, one unchecked assumption in the model is how much influence a member of the military elite has on other agents surrounding it. Although it is difficult to put a quantitative value on this qualitative parameter, it forces the modeler to consider this question that was not considered before.

²⁴ Berger, 248

²⁵ Johnson, Paul. (1998): *Rational Actors versus Adaptive Agents: Social Science Implications*. American Political Science Association 1-22. <http://pj.freefaculty.org/Papers/APSA98-MTHDS/APSA98 Methods>.

Another concern discussed by Axtell is the lack of information that a single run provides. Unlike mathematics, running the model reveals little about the social system. Axtell writes, “a single run does not provide any information on the robustness of such theorems. That is, given that agent model *A* yields result *R*, how much change in *A* is necessary in order for *R* to no longer obtain?”²⁶ The way to solve this problem is through running the model for multiple scenarios. Virtual Pakistan is run for 500 trials, which should solve the problem posed by Axelrod. Furthermore, each trial is unique because of stochastic perturbations.

While there are many limitations to agent-based modeling, it provides a more effective platform to model Pakistan than the CFR’s qualitative model. The arguments stated above list reasons why the model should, in theory, provide a more effective way to examine Pakistan’s future. The following sections will test this hypothesis by explaining the model building process and comparing the experiment and results with those suggested by the CFR.

4. Understanding the Internal Political Dynamics of Pakistan

Building an effective agent-based model of Pakistan requires both understanding the internal political dynamics of the society as well as having command over a modeling platform. This agent-based model, constructed using the PS-I software, involves the compilation of a series of scripts. These scripts specify information about the nation, including the geographical mapping of provinces and districts, the religious, ethnic, political demographics, the types of elites in the country and the theories that are driving the behavior of the model.

Section 3, divided into five subsections, discusses the qualitative information found in these scripts. Readers interested in the computer programming aspect of the model should

²⁶ Axtell, Robert. (2000) "Why Agents? On the Varied Motivations for Agents Computing in the Social Sciences". *Center on Social and Economic Dynamics – Working Paper*: 1-22.
<http://www.brookings.edu/~media/research/files/reports/2000/11/technology%20axtell/agents>.

reference the Appendices. The first section, the Dynamic Political Hierarchy explains the main theory governing behavior in Virtual Pakistan. The second section, explains the various identities the model represents. The third section discusses the elite networks in the model. The fourth section explains the temporal and spatial elements of the model. The fifth section, the Generic Political Model, operationalizes the rules outlined in the Dynamic Political Hierarchy theory and serves as a base for the other scripts.

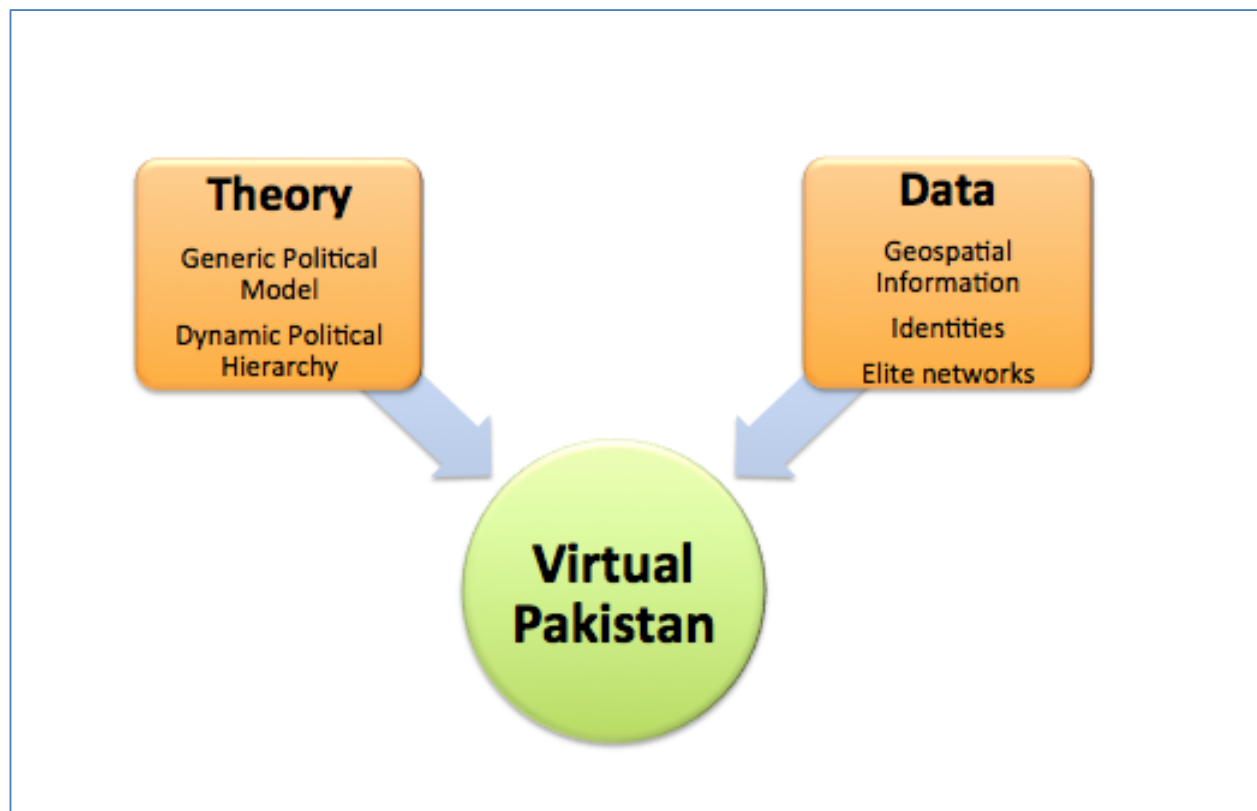


Figure 1: Ingredients involved in creating Virtual Pakistan

4.1 The Dynamic Political Hierarchy (DPH)

Before creating the model, the researcher identifies and operationalizes a theory that will govern behavior. In this model, the Dynamic Political Hierarchy serves as the theory directing societal structure and group behavior.²⁷ The DPH classifies identities and predicts possible

²⁷ Lustick, I., Alcorn, B., Garces, M., & Ruvinsky, A. (2010). From Theory to Simulation:

mobilization patterns of agents based on these classifications. The DPH assesses the landscape at every time step and assigns identities into one of five categories – dominant, incumbent, regime, system and non-system. The category that each agent automatically falls into, as well as its level of anger, determines its mobilization patterns. An agent becomes “angry” when it feels as if it is not living up to its potential because it identifies with a group that is currently not treated as favorably in the society than another group in its repertoire. Thus, each agent’s mobilization in society develops endogenously, without the researcher inputting his or her bias into the system. The DPH operationalizes three distinct theories - Cross-Cutting Cleavages, Nested Institutions and Dynamic Loyalties.

Cross-Cutting Cleavages theory explains that people’s overlapping identities often impact their political behavior. For example, someone who belongs to an isolated ethnic group may share other non-ethnic identities in common with the majority; this overlap in identities may prevent the person from the isolated ethnic group from feeling completely excluded and acting violently. The Nested Institutions is based on David Easton’s theory of political institutionalization, in which he claims citizens’ connection to the political elites constantly change. The Nested Institution theory is reflected in the five different categories through which agents can feel connected or disconnected to the regime; these five categories are called dominant, incumbent, regime, system and non-system. Depending on the overlap of identities in an agent’s repertoire, an agent will lobby, protest or use violence to express its concerns. The third theory, the Dynamic Loyalties theory, explains that individual groups, and hence societies are dynamic and constantly changing. In other words, a group that begins politically powerless in

the model may acquire followers and raise their status in society.²⁸

These three theories are operationalized in the DPH and combined “into a mechanism that regulates the intensity of political conflict based on the presence or absence of overlapping affiliations.”²⁹ The dominant identity in Virtualizations is the identity with which the plurality of agents openly identify. The incumbent identity overlaps with the dominant identity in over 70% of the dominant agents.

Agents who subscribe to identities in either of these two categories feel relatively included in society and lobby the government to express concerns. Agents who are not subscribed to dominant or incumbent level identities, but only to regime level identities will protest when politically mobilizing in the nation. An agent who is activated on an identity at the system level could lobby, protest or even use violence to express its unhappiness, depending on which other identities are in its repertoire. If an agent is activated on a system-level identity, but has a dominant or incumbent level identity in its repertoire, the agent will lobby when politically mobilizing; if an agent activated on a system-level identity has a regime level identity in its repertoire, it will protest to express concern and if the system-level agent has only other system or non-system level identities in its repertoire, it might use violence. An agent activated on an identity categorized in the non-system level that does not share the dominant, incumbent or regime level identities in their repertoire is the most removed from society. When an agent is a system or non-system agent and it is angry, it looks for targets to attack. If there are agents within its attack distance, there is a 10% chance that one of the agents will become its victim.³⁰

The DPH serves as a module designed to represent political and mobilization implications of various patterns of interest and group alignments. However, the DPH lacks

²⁸ Lustick, 9

²⁹ Ibid, 7

³⁰ Appendix A, DPH coding and translation

specific details about Pakistan's society and state. The following sections discuss the operationalization of this theory, Pakistan's elite networks, identities, and internal and external affairs to complete the model building process.

4.2 Identities

The DPH assigns categories and drives mobilization patterns based on the identities that agents adopt. Thus, deciding which identities to include or exclude is an extremely important task. Identities consist of those characteristics with which people self-affiliate. In the model, each agent has various identities in their repertoire. Every time step, the identity that an agent is activated on has the ability to change. An activated identity refers to the group or affiliation that is driving an agents' behavior at any given time step. A subscribed identity refers to all of those identities that are in the agents' repertoire.

An assumption in the model is that an agent's activated identity drives their current political behavior. Thus, all of the identities mentioned in this section are politically relevant to Pakistan's political situation. An agent can subscribe to the ethnic, religious, political party and other identities described below.

4.2.1 Ethno-linguistic identities – Punjabi, Sindhi, Pashtun, Balochi

The most basic ethnic identities in Pakistan are Punjabi, Sindhi, Balochi, Pashtun Muhajir, Afghani and Kashmiri.³¹ In addition to these identities, the model includes Saraiki and Urdu. Prior to Pakistan's independence in 1947, it was a colony of Great Britain. During this time, regional identities became increasingly important. This is especially true for provinces such as Punjab and immediately following partition, Bengal. Although Bengal is no longer part of

³¹ Khan, I. (2006). Contending Identities of Pakistan and The Issue of Democratic Governance. *Peace and Democracy in South Asia*, 2(1 and 2), 50-70.

Pakistan, Punjab, to this day, maintains the strongest regional identity in the nation. Strong presence of regional identities may reveal that the people place their regional concerns ahead of their national, religious or socioeconomic concerns.

4.2.1.1 Punjabi

Punjabi is the most prominent provincial identity in Pakistan, with almost 45% of the population speaking Punjabi.³² Punjabis from different parts of the province vary in their occupations, socio-economic statuses, ideologies and even customs. Southern Punjab is primarily rural while other areas such as Lahore, are most bustling urban areas in all of Pakistan. While there are many nuances within the Punjabi identity, this model serves as a simplification of a complex reality. Most Punjabis are found in the Punjab province; however, there are Punjabis all over Pakistan and this has been accounted for in the model.

4.2.1.2 Sindhi

The Sindhi identity is prominent in the Southeastern part of Pakistan with 14% of the population speaking Sindhi.³³ The province of Sindh includes influential cities such as Karachi as well as some of the most rural parts of Pakistan. Similar to Punjab, Sindh has a large landowner population. Because they are next to Balochistan, there is also some portion of the Sindhis who are located in Balochistan.

4.2.1.3 Balochi

The Balochi identity is the smallest ethnic population in Pakistan with roughly 5 million people out of 180 million associating with this group. Residing mostly in Balochistan, they are

³² *PAKISTAN - CENSUS* [Data]. Retrieved December 2, 2011, from Government of Pakistan website: <http://www.census.gov.pk/index.php>

³³ *PAKISTAN - CENSUS* [Data]. Retrieved December 2, 2011, from Government of Pakistan website: <http://www.census.gov.pk/index.php>

primarily rural and tribal. The capital city of Balochistan is Quetta, and even this city is not nearly as large as some of Pakistan's other urban areas.

The Balochi people have often felt alienated from the central government. A small segment of the Balochi people began the Balochistan Liberation Army (BLA), a separatist movement against the Pakistani state. They believe that the government and military regimes were taking advantage of their gas field revenues. Not only have these requests been ignored, but also other issues have infuriated the Balochis. For example, in 2004, President Musharraf constructed a cantonment for new troops and authorized the building a the Gawadar port on the Makran Coast; both of these infuriated local Balochis, many of whom had to give up jobs, homes and land. The BLA drew international attention to these issues by using terrorist tactics including bombing pipelines, electricity pylons, and telephone exchanges. While this group is not very large, they represent the sentiments of many common Balochis who feel alienated from and resentful towards the central government.

4.2.1.4 Pashtun

Pashtun is another prominent identity in Pakistan with 15% of the population speaking Pashto.³⁴ Pashtuns also have diverse sub-cultures and socio-economic statuses. Similar to the Punjabi identity, there are nuances within the Pashtun identity. For the purposes of this abstract model, the Pashtun identity acts as an umbrella identity. Pashtuns are found mostly in Khyber Pakhtunkhwa and the Federally Administered Tribal Areas; however there is a substantial number, roughly 30%, of Pashtuns in Balochistan.

³⁴ *PAKISTAN - CENSUS* [Data]. Retrieved December 2, 2011, from Government of Pakistan website: <http://www.census.gov.pk/index.php>

4.2.1.5 Muhajir, Afghani, Kashmiri

Muhajir refers to the group of Pakistanis who migrated from India during the partition. Often times, these migrants moved to work in the central government. The Afghani identity is also important because a substantial portion of the population migrated to Pakistan during and after the 1980s War in Afghanistan and more recently since the NATO invasion of Afghanistan in 2001. The Kashmiri population in Pakistan mostly resides in the northeastern areas of Pakistan and seeks independence. Because the census data lacked statistics on these three ethnic categories, they were not seeded into this specific model. However, when data becomes available, these categories have been created as placeholders.

4.2.1.6 Saraiki

Saraiki is a language spoken in Southern Punjab and mostly found in rural areas. The Saraiki identity is included because of claims that the Punjabi identity could not accurately serve as one umbrella identity.³⁵ This identity was also included because the data was available in the 1998 census.

4.2.1.7 Urdu

Although most people in Pakistan understand Urdu, it is often times not the first language for the majority of the people. Urdu is the official language of Pakistan and was once the language of the power centers in India and the Mughal Empire. The identity is associated with the upper class Muslim elites in Pakistan. More specifically, many middle class Punjabis speak Urdu both inside the house and out in public. A very small portion of the population claims Urdu is their primary language in the census data and therefore it is unlikely it will serve as a unifying identity.

³⁵ Interview with Pakistan's International Crisis Group Director Samina Ahmed

4.2.2 Religious Identities – Sunni Muslim, Shia Muslim

Pakistan has become increasingly religious in the past few decades. Since the defeat of the Taliban and the War in Afghanistan, the number of Islamic extremists within the society has increased exponentially. This increase has led to more sectarian violence as well as some speculation that Pakistan will become an Islamic state.³⁶ The religious identities, therefore, may play a significant role in the nation's political future and need to be included. The religious identities considered in this model are Sunni Muslim, Shia Muslim, Christian, Qadiani, Hindu, Scheduled Caste and more.

4.2.2.1 Sunni Muslim

The Sunni Muslim identity is one of the most common identities in Pakistan, with almost 75% of the population associating with Sunni Islam at some capacity.³⁷ However, not all of the people who identify with Sunni Islam share the same definition of this identity. In Pakistan, a substantial portion of the population is Muslim only by name. They may associate with the religion for traditional or cultural reasons, and may not practice Islam. More importantly, these Pakistanis are less likely to identify with any type of political movement that would emerge under the name of Sunni Islam. Because not all 75% of the Sunni Muslims in Pakistan would actually identify with a movement, the model accounts for this and places a limit on how many agents in each province can acquire the Sunni Muslim identity.

4.2.2.2 Shia Muslim

Shia Muslims are the second largest religious sect in Pakistan. Approximately 15% of the population associates with this identity. Recently, Shia Muslims have been victims of terrorism

³⁶ Interview with Dr. Rifaat Hussain. Chair of International Relations Department at Quaid-e-Azam University,

³⁷ *PAKISTAN - CENSUS* [Data]. Retrieved December 2, 2011, from Government of Pakistan website: <http://www.census.gov.pk/index.php>

from Sunni Muslim organizations in Pakistan.³⁸ Similar to the Sunni Muslim identity, there is a limit on how many people will identify with this religion.

4.2.2.3 Other religious minorities: Christian, Qadiani, Hindu, and Scheduled Caste

In addition to the widespread Muslim identities, some Pakistanis associate with other religions such as Christian, Qadiani, Hindu and Scheduled Caste. These figures were included in the model because the 1998 population census data included these statistics; however, it is extremely unlikely that these groups will impact the model drastically.

4.2.3 Political Party Identities – PPP, PML-N

The political parties are an important part of this model because they show the different families vying for power in the country. Unlike in the United States where the Democrats and Republicans have extremely different perspectives and have two distinct visions for the country, the political parties in Pakistan lack such ideological platforms. There are a number of political parties, some are more liberal and popular than others, but they do not preach fundamentally distinct ideals. Political parties do not overlap with specific ethnic groups in this model, but there are patterns of affiliation with specific parties. For example, many PPP members are Sindhi,³⁹ and many PML-N members are Punjabi.

4.2.3.1 PPP

The Pakistan People's Party is Pakistan's most influential and popular political party. The PPP is originally the party of the Bhuttos, namely Zulfikar Ali Bhutto and Benazir Bhutto. Asif Ali Zardari, Benazir Bhutto's husband, currently leads the party and serves as the President of

³⁸ Qadri, M. (2012, April 19). Pakistan is in denial over spreading sectarian violence. <http://www.guardian.co.uk/commentisfree/2012/apr/19/pakistan-sectarian-violence>.

³⁹ Pakistan poll: President Zardari party 'makes gains'. (2012, March 2). *BBC, Asia*. Retrieved from <http://www.bbc.co.uk/news/world-asia-17225502>

Pakistan. The PPP's base resides in Sindh; however, a significant portion of Northern Punjab also associates with the PPP.

4.2.3.2 PML-N

The Pakistan Muslim League (N) is the only realistic competitor of the PPP. It is the only other political party that has won a civilian government election. Nawaz Sharif is the leader of this political party. This party's political agenda is very similar to that of the PPP. PML-N's political base is in Punjab.

4.2.3.3 Other Political Parties

The remaining five parties included in the model are PML-Q, ANP, MMA, MQM and PPP (S). PML-Q is former President Musharraf's Pakistan Muslim League and has many supporters. President Musharraf recently returned to Pakistan to lead his party for the elections in May 2013.⁴⁰ ANP, the Awami National Party, is a leftwing Pashtun party. MMA, Muttahida Majlis-e-Amal, which is a right wing religious party, gained support in Khyber Pakhtunkhwa. MQM, Muttahida Qaumi Movement, is a political party that gained support in Sindh. PPP (S), another faction of the Pakistani People's Party was named after Aftab Ahmad Sherpao. While not all of these parties have substantial support, these were the seven major parties, which had comprehensive data available.

⁴⁰ Waraich, O. (2013, March 29). The Return of the General: Why is Musharraf Running for Office in Pakistan? *Time*. <http://world.time.com/2013/03/29/the-return-of-the-general-why-is-musharraf-running-for-office-in-pakistan/#ixzz2P0LzWWDv>

4.2.4 Societal Identities – state, nationalism, globalism, military,

In addition to regional, religious and political identities, this model includes other identities mentioned in survey data.⁴¹ These identities reflect the type of government and society that Pakistanis desire could insinuate a change of government if enough people associate with them.

4.2.4.1 State

The state identity describes an individual who works in the bureaucracy or supports the current state apparatus as it is. This is different from the nationalist identity, which describes an individual who supports the idea of Pakistan but not necessarily the central and civilian state apparatus such as the legislative branch, the executive branch or bureaucracy.

4.2.4.2 Nationalist

The Pakistani nationalist represents people residing in Pakistan who view themselves as Pakistani “above all else,” as opposed to Muslim or Punjabi or any other identity “above all else.” Unlike the state identity, this reflects the people who support the idea of Pakistan rather than the actual state or military apparatus. These people would actively oppose any efforts of a separatist movement.

4.2.4.3 Globalization

Pakistanis who support economic and political integration with the Western world associate with the globalization identity. This identity specifically uses survey data from the Asian barometer and seeds agents based on the number of Pakistanis who disagreed with the statement that U.S. culture is ruining Pakistan. Pakistanis who answered “no” to this question support the integration of Western cultures into their own.

⁴¹ Appendix C includes the specific Survey and question used to determine the data for each of the “other identities”

4.2.4.4 Military

The military is Pakistan's most influential and complex institution. In Pakistan's short 65-year history, there have been three military coups by General Ayub Khan, General Zia-ul-Haq and General Musharraf. Military coups, often times were welcomed in Pakistan because of the ineffectiveness of civilian rule. The military identity is seeded according to a survey question asking how many people in the country approve of or associate with the Pakistani military's actions. Throughout history, the Pakistani military has maintained widespread approval. In the last few years, however, this has slightly changed. Pakistanis dislike the army's collaborative relationship with the United States and Americans dislike the Pakistani army's friendly relations with Pakistan's intelligence agency, ISI, and religious groups. The military's precarious and dynamic role in Pakistan makes it one of the most interesting identities in the model.

4.2.4.5 Jihadi identity

The Jihadi identity refers to those Muslims who are products of the madrasas in Pakistan or have joined an Islamist organization. Most of the time, people who identify as Jihadis follow a strict, Arab Wahabi interpretations of Islam. Over the last 7 years, these Jihadis or violent non-state actors have become a source of internal conflict in Pakistan. Violent non-state actors are those individuals who either belong to or associate themselves with terrorist organizations, but are not necessarily originally from Pakistan. These people, therefore, are not interested in the survival of the state in its current form and most of these people want a change of regime. Some of the terrorist organizations to which non-state violent actors subscribe are Al Qaeda, the Haqqani Network, Tehreek-e-Taliban, Lakshar-e-Toiba and many more. While they are clearly a significant group in the region, the Jihadi identity in this model lacks the nuances mentioned in this analysis.

In this model, the Pew Research Center's data only revealed the number of people who sympathize with extremist groups in Pakistan at the national level. There is no data revealing how many people support these ideologies per province; thus only national data is used.

4.2.4.6 Criminal/Corrupt

The criminal/corruption identity refers to those agents who willingly engage in fraudulent behavior. This practice is common in Pakistan among politicians and business elites. Pakistan's political elite has a reputation of corrupting the nation; at one point in time, President Zardari's nickname was "Mr. 10%" because of corruption charges against him.⁴² Based on survey data, agents with the corrupt identity believe that accepting bribes is acceptable in certain cases.

4.2.5 Socioeconomic Identities

Socioeconomic identities play an important role in Pakistani politics. Although the middle class is growing, most Pakistanis are extremely poor. Such poverty has created an uneducated, unemployed, uninsured and vulnerable society. Without economic reform in the future, Pakistan will continue to struggle with nation building efforts and see little political change. Tracking socioeconomic identities also allows the researcher to see how the economic identities compare to political, ethnic, religious and other identities.

4.2.5.1 Poor

Pakistan's poverty level has remained high throughout its history. The Social Policy and Development Center defines poverty as anyone who earns less than 1,984 rupees in rural areas and 2,248 rupees in urban areas. They chose 1,984 because according to their research, 2,248 rupees were needed in order to buy the minimum number of calories in an urban area and 1,854

⁴² Profile: Asif Ali Zardari. (2011, December 7). *BBC*, Asia. Retrieved from <http://www.bbc.co.uk/news/world-asia-16066406>

rupees were needed in order to purchase the minimum number of calories in rural areas. SPDC released estimates on the level of poverty in each region in Pakistan, claiming that 37% of residents in the NWFP were considered “poor,” 60% in FATA, 31% in Punjab, 25% in Sindh and 34% in Balochistan.

4.2.5.2 Middle Class

Pakistan’s middle class has increased over the past few years. The definition of middle class used is “a class occupying a position between the upper-class and the lower-class ... a fluid heterogeneous socioeconomic grouping composed principally of business and professional people, bureaucrats, and some farmers and skilled workers sharing common social characteristics and values.”⁴³ According to this definition, Pakistan’s Institute of Development Economics estimates 40% of the nation is in the middle class⁴⁴.

4.2.5.3 Wealthy/Upper Class

Pakistan’s upper class composes a small percentage of the nation. Because there are no statistics on the percentage of wealthy people in Pakistan, Virtual Pakistan assumes that 80% of the elites are wealthy, and none of the basic agents are wealthy at the initial time step.

4.3 Elite Networks and Influential Agents

Every agent in the model has a repertoire of identities. Each agent selects, retains and releases identities differently depending on its agent class. An agent class refers to a group of agents that behave the same way based on their settings as will be discussed further in the Generic Political Model section.

⁴³ Nazar, Y. (2012, April 9). Is the middle class that big? *Dawn*. <http://dawn.com/2012/04/09/is-the-middle-class-that-big/>

⁴⁴ <http://www.pide.org.pk/pdf/Working%20Paper/WorkingPaper-77.pdf>

Virtual Pakistan consists of two types of agents: basic and influential. Basic agents have low influence levels and only gather information from their neighbors to make decisions. Influential agents or “elites” can influence more agents in the model and can listen to and gather information from other elite agents. There are three types of influential agents in the model: political, military and business elites. This section uses scholarly political analyses of Pakistan to discuss the creation of elite networks.

Saeed Shafqat writes in his chapter, *Praetorianism and the People*, that four elements help democracies grow. He chooses to focus on democracy’s functionality based on “elites’ ability to bargain, compromise, and build consensus on the normative aspects of democracy.”⁴⁵ His analysis examines four different elites in Pakistan – military elites, bureaucratic elites, political elite and religious elites and analyzes their respective roles in the country. Some of the information in his chapter supports the creation of the elite networks.

Another author, Anatol Lieven, examines four different elite forces driving Pakistan as well. He focuses on the influence of the judiciary, religious, military and political institutions. Examining the impact of the judiciary, Lieven discusses the role of the Shariah, the impact of the Lawyer’s Movement, the influence of the Courts and more. Explaining Pakistan’s religious elites, Lieven discusses the intersection between Sufi Islam and extreme Wahabi Islam. He elaborates on the political elites elected to office because of their saintly status and the expansion of radicalism and growth of madrassas. Next, he discusses the military elites in great detail, describing the army’s multiple military coups, the role of the ISI and the military’s control over Pakistan’s nuclear weapons. Finally, he discusses the political landscape, the relationship

⁴⁵ Shafqat, S. (2011). Praetorians and the People. In M. Lodhi (Author), *Pakistan: Beyond the 'Crisis State'* (pp. 95-112). New York, NY: Columbia University Press

between the military and civilian government and the influence that the Pakistan People's Party and the Pakistan Muslim League have maintained over the nation since 1970.

These sources and other data and articles contributed to the creation of Virtual Pakistan's four elite networks – state, military, business and religious elites. In both sources, authors suggested that the military and political elites were the most important elites present in the nation, as Pakistan has oscillated between military and civilian control since its founding in 1947. Thus, these elite networks are present in the model. The state elite network consists of the civilian government, politicians and the bureaucracy. Although Pakistan's bureaucracy is a separate and more dominant institution than its civilian government, this model treats the bureaucracy, executive and legislative elites as one elite network titled "state." In addition to the state elites, the military elites are included in this model. The military elites remain one of Pakistan's most dominant groups as they have taken over the country three times in Pakistan's history and constantly stand as a threat to the civilian government.

The business elites are incorporated into the model even though neither author explicitly addresses this group as a potential force. This model also includes the business elite because of the immense amount of corruption and control that the businessmen have in Pakistan. Weak institutions have allowed the business elites to become an important force. The religious elite are included in this model as both authors discuss their value. They, however, lack the complexity of the state and business elite networks.

4.3.1 State Elites

State elites in this model represent all individuals affiliated with Pakistan's civilian institutions. This refers to politicians and bureaucrats. State elites consist of the President, Prime

Minister, provincial governors, National Assembly members, provincial legislators and all types of bureaucrats.

Because specific data regarding the ethnic composition of the state elites was unavailable, the percentage of ethnic groups and additional identities was inferred based on general knowledge of the country. Knowing that the two major political parties in Pakistan are the Pakistan People's Party (PPP) and the Pakistan Muslim League (PML-N)⁴⁶ and knowing that PPP primarily consists of Sindhi⁴⁷ and PML-N primarily consists of Punjabi, these two ethnic groups make up most of the state elite. In this model, 35% of the state elites are seeded as Punjabi and 25% are Sindhi. Pashtuns are 10% of the state elite as they maintain some influence through the Awami Muslim League's alliance with the PPP. Balochistan only composes 5% of the state elite as it has a relatively smaller population and representation than the rest of the provinces. Punjabi and Sindhi also maintain a higher percentage of the state elite because these two groups compose most of the bureaucracy.

All of the state elites are given the state identity because it can be assumed that by working for the government, they are affiliated with the central government as an institution; Most, but not all, of the state elites are given the nationalist identity (70%) because some politicians' actions create the impression that they place their sectarian and or business interests above the national interests. 25% of the state elite, more than any other group, have the corruption identity because many Pakistani politicians, including the current President, have been caught stealing from the nation. The rationale for this high seeding is also based on Lieven's description of electing politicians as he says, "a very large proportion of the money

⁴⁶ Shafqat, 101

⁴⁷ Lieven, 236

made from corruption has to be recycled downwards through patronage or straight gifts.”⁴⁸ This reveals the institutionalized nature of corruption in the state elite networks. Less than half of the state elites, 40%, have the military identity based on the historical rivalry between the military and civilian institutions. Anatol Lieven discusses the complicated relationship regarding state and military as he writes, “Many of Mr. Sharif’s own ministers would come to see [Shuja Nawaz’s] brother (Four-Star General) to complain about the PM and ask the military to throw him out and replace him with someone else”⁴⁹ This reveals that some of the state elites support the military as a way to overthrow the current politicians. The business identity is infrequent in the state elite, 40%, but present nonetheless, because many politicians are tied to the private sector. For example, the President of Pakistan, Asif Ali Zardari, is originally from a family that owned one of the largest cinemas in Karachi.⁵⁰ None of the politicians are seeded with the USA/Globalizing identity because in Pakistan’s current state, few to no politicians show allegiance to the West out of fear of being targets of Islamists.

The state elites’ political party identities are seeded according to the political divisions in parliament. Currently, the parliament includes 30.6% PPP members, 19.6% PML-N members, 2% ANP members, 2.2% MMA members and 7.4% MQM and .04% PPP-S. Although these numbers exclude bureaucratic affiliations, one can assume that bureaucrats will not reveal their partiality towards a specific party and as a result, their political party affiliations are less important.

⁴⁸ Lieven, 215

⁴⁹ Ibid.165

⁵⁰ Perlez, J. (2008, March 11). From Prison to Zenith of Politics in Pakistan. *New York Times*. http://www.nytimes.com/2008/03/11/world/asia/11pstan.html?pagewanted=1&_r=2

4.3.2 Military Elites

The military elites in Pakistan remain one of the strongest groups in the country as they have overthrown past civilian governments, controlled a significant portion of land and maintained popular opinion for most of the nation's history. Military elites in this model represent the high-ranking officials in Pakistan's military. The military elites are those individuals directly in the military, while the military identity refers to Pakistanis who supports the military, including veterans. Most of the military elites, therefore, associate with the military identity. Members of the military include ranked officers such as Generals, Lieutenant Generals, Major Generals, Brigadiers, Colonels, Lieutenant-Colonels and more.

The ethnic composition of the military includes 57% Punjabis, 14.5% Pashtuns, 17% Sindhis, 4% Balochis and 7.5% others.⁵¹

The military elites' other identities were seeded according to qualitative data available in Saeed Shafqat and Anatol Lieven's book. Most of the military elites are seeded with the Pakistani nationalist identity. Lieven writes, "The military's obsession with India and Kashmir is not in origin Islamist, but Pakistani Muslim nationalist. With rare exceptions, this has been true even of those senior officers most closely involved in backing Islamist extremist groups to fight against India, like former ISI chief Lt. General Hamid Gul."⁵² This information supports the high percentage, 80%, of military elites affiliated with the nationalist identity. Unlike the nationalist identity, 50% of the military elites have the state identity. This is because while many military elites support the idea of the central government, they do not necessarily support the disorganization of the central government. As a result, there are fewer military officials who support the state. There is a small connection between the military elites and the corruption

⁵¹ Khan, S. B. (2007, September 14). Punjab's dominance in army being reduced: ISPR. *Dawn*.

⁵² Lieven, 187

identity. Lieven discusses the matter as he writes, “Outright individual corruption in Pakistani military is as one would expect centered on weapons, procurement and those branches of the military dealing with civilian business” He continues and writes that cases of corruption in the Pakistani military, “seem to be relatively rare – and, by the standards of Pakistan in general, remarkably rare.” Thus, the Pakistani military was given a smaller percentage, 5%, of corruption than any of the other elite networks.

Unlike the other elite networks, the military elites have no connections with the political parties in this model based on their independence from the civilian government. Thus, none of the military elites identify with any of the political parties in the initial condition.

4.3.3 Business Elites

Unlike the military and state elite networks, the business elite consists of a wide spectrum of industries and people. Pakistan’s business elite consists of those individuals who are private small business owners, small industry elite, landowners of small plots, big industry elite and landowners of large industry. Some of the industries involved in the elite networks are the truck owners association, the oil industry, gas industry and large banks. They are important because they often control the less apparent elements of the Pakistani political sphere. For example, the Pakistani Trucking Association, one type of business elite, has the power to cut off NATO’s military supply route. Most of the ethnic, political party and additional identities of the business elite are estimates based on general information

The business elite’s ethnic breakdown consists of 35% Punjabi, 25% Sindhi, 10% Pashtun and 5% Balochi. These estimates are based the assumption that since the Punjabis and Sindhis have the most political power, they may also provide the most funds to support business in Sindh and Punjab. Similarly, most of the landowners are from these two regions. Khyber Pakhtunkhwa

and Balochistan have less political power and smaller populations, thus, the business elite in this model are 10% Sindhi and 5% Balochi. These numbers are estimates and susceptible to change.

Additional identities and political parties followed a similar pattern. Lieven writes briefly about the business elite in his description of the military claiming that, “As in some western societies, but to a far greater extent – retired soldiers, are also prized by private businesses and NGOs for the qualities of discipline, honesty, hard work, and indeed higher education that they have acquired during their military service – qualities which alas are not so common in wider Pakistani society.”⁵³ One can assume that they are interested in the success and functionality of the country because they have built the connections allowing them to succeed in their respective industries; thus, over half of the business elite are given the national identity and nearly three quarters are seeded with the state identity. All of the business elites are given the business identities. While it is unclear how many of them are corrupt, one can assume that they are more corrupt than the military and less corrupt than the state elites who rely on bribes and patronage to votes. Thus, 15% - a value between the amount of corruption in the military and state elites - of the business elites are corrupt.

4.3.4 Religious Elites

The religious elite refers to those who attend or oversee madrassas, religious clerics who give political sermons, leaders of the religious political parties and families that use Islam or relations to the Prophets or Saints to acquire political power. Pakistanis often view Islam differently from one another and lack a single cohesive ideology as it has mixed both Sufism and Wahabi Islamic fundamentalism.

⁵³ Lieven, 167

In the past, Sufism has played a large role among the Islamic elites. For example, Sufi shrines are widely visited by people of both Shia and Sunni sects. People related to Sufi saints are widely respected and often these saints, known as pirs, are elected to political office on that basis alone. At the same time, the moderate religious class is also growing. For example, in January 2013 a religious cleric named Tahrir-ul-Qadri led a long march to Islamabad to change political reform under the name of Islam. Leaders from madrassas, religious political parties and clerics are all considered part of this group. Thus, a religious elite can be anyone in a position of power who chooses to view the political situation through the lens of Islam.

The model accounts for the diverse nature of the religious elite by treating this elite network different from the other three elite networks. At every time step, the model selects a few agents who are activated on the Sunni Muslim identity and provides them with a higher influence level than a basic agent. Increasing their influence level slightly, the model accounts for the unpredictable and flexible nature of the religious elite. Another reason this method differs is because unlike other elites, religious elites lack the same institutional listening rules and hierarchy. Religious elites may be able to exert influence over a large population in their respective regions but they do not always listen to the state, military or business elites

4.4 Temporal and Spatial Elements

4.4.1 Geographical Landscape

Knowing the geographical features of a country is one of the most important parts of building a model. Geographic Information Systems (GIS) simplify a complicated process of translating the exact locations of specific provinces, divisions, districts, cities and ethnicities on the model. GIS files provide specific data on each of these matters. Using the techniques expressed in this section facilitates the process for anyone who would want to replicate either

this model or build another Virtualization. The final model includes five GIS files: three of which map out the provinces, districts and divisions, one that maps out the settlement points and another that maps out ethnic distribution.

4.4.1.1 Provinces, Administrative Divisions and Administrative Districts

The first three GIS files mapped out all of the provinces, divisions and districts of Pakistan. Every district's projected population in 2009 was entered into the GIS's district file.⁵⁴ The population data modified the shape of the Pakistan map such that areas with a denser population had more agents than areas with smaller populations.

4.4.1.2 Settlement Points

After the provincial, divisional and district boundaries were established, another GIS file containing the settlement points and major municipalities of the country added another layer of detail to the map (Appendix E). Since influential people often reside in populated cities, this file helped seed the location of influential Cs in Pakistan.

4.4.2 Temporal Elements

Each trial ran for 100 time steps. Scholars in the CFR report state that they are examining Pakistan's future for roughly the next 10-15 years. Because the CFR report did not specify exactly how many years in the future the five possible trajectories would occur, this experiment does not specify how many time steps equal one year.

4.5 Generic Political Model

The Generic Political Model (GPM) is among the most important components as it binds everything in the model together. Within the GPM, a module operationalizes all of the rules

⁵⁴ *Pakistan population 1998 and 2009 by district all provinces* [Data file]. (2009). Retrieved from <http://onerresponse.info/countries/pakistan/im/Pages/IM.aspx>

mentioned in the DPH. Later sections of the GPM define and tie together attributes and terms referenced in other scripts.

The GPM serves to define and codify all of the important elements of the model. It is composed of multiple sections and specifies information such as the agent attributes, agent classes, routines, the dimensions of the model and parameters, bias update routines, subscribed bias tests, tension codes, mobilization routines, display routines, rules, views and statistics. The GPM ties together all of the previously referenced elements of the model, including the geographical landscapes, identities and elite networks. In order to make this point, one can examine the first section of the GPM in which the different attributes are listed.

4.5.1 GPM: Agent Attributes

Agent attributes are those parameters that only modify agent behavior. The most important agent attributes include influence level, rotation trigger, substitution trigger, activation substitution trigger and sight range. These attributes impact the agent's behavior in the following ways:

- a. **Influence level** controls the likelihood that a neighboring agent will adopt another agent's identity.
- b. **Rotation trigger** controls the rigidity of an agent's activated identity. Agents with high rotation triggers adopt new activated identities less frequently.
- c. **Substitution trigger** controls the rigidity with which an agent acquires a new identity
- d. **Activation substitution trigger** controls the rigidity with which an agent acquires a new identity and automatically activates on that identity
- e. **Sight range** controls an agent's zone of knowledge as measured by the depth of proximate agent field that is monitored.

Each of these attributes modifies an agent's behavior. Most agents in the model are called "basic" because they use the default parameters; the elites, however, have higher sight ranges signifying that they have more knowledge than the average person and maintain higher influence levels signifying that their opinions hold more weight in society.

There are other agents' attributes that control whether an agent is acting violently, protesting, etc. These attributes allow the DPH to work effectively. All components of the Attributes section contribute to the agent behavior. Combinations of different attributes create unique agent classes.

4.5.2 GPM: Agent Classes

The next section of the GPM creates different agent classes. As discussed in the bounded rationality section earlier, agents can have different levels of knowledge and computing power. In this model, agents can be either basic, or "Influentials." In the real world, basic agents represent people in Pakistan who individually have little to no influence in the country's political affairs and mostly interact with their immediate neighbors. "Influentials" represent the political, military and business elites in the country who have the most influence in the nation and interact with other influential actors. While basic agents interact with neighbors who are directly next to them, elites interact with other elites regardless of their geographical location. The model consists of five different types of elites: InfluentialA, InfluentialB, InfluentialC, InfluentialD, InfluentialE. InfluentialAs have slightly more influence than basic agents and InfluentialE has the highest influence level in the model.

4.5.3 GPM: Field Commands

Within the Generic Political model, the field commands section controls the dimensions and size of the model.

4.5.4 GPM: Parameters

Another important function of the GPM can be found in the ‘parameters’ section. While there are many parameters, the most important parameters are called the bias seed, the bias max, bias min, the evolution seed and more.

The biases are important in that they ensure a level of randomness in the model. As discussed earlier, agent-based modeling requires Monte Carlo technique simulations because running the model once does not reveal much. The “bias seed” ensures that every trial reveals a distinct trajectory by creating unique initial conditions. All identities are assigned a bias; identities with high biases are favorable and those with low biases are unfavorable. A trajectory can be dramatically altered depending on an identity’s bias. For example, if the military identity has a high bias and state has a low bias in a single trajectory, the military identity is more likely to dominate the landscape. The bias max and min, also defined in this section, set the range of favorability of each identity. For example, an identity with a bias max and min of 0 to 4 will always be favorable since it, can only have a positive bias, whereas an identity with a bias range of -4 to 0 will always be unfavorable since it can only have a negative bias. In this specific model, the default bias range is -3 to 3, implying that every identity has an equal opportunity to be favorable or unfavorable. The bias volatility expresses the instability in the region. In this model, the bias volatility is 10%, meaning that the region is stable most of the time. This parameter was not altered in order to maintain some degree of control over the experiment. The evolution seed is also significant because it ensures that each agent transforms with some degree of randomness.

4.5.5 GPM: Rules

The GPM also includes the rules of the model. As mentioned earlier, many of the DPH theories discussed abstractly in the model are operationalized in this section of the model. In this section, basic agents mobilize by lobbying, protesting, attacking or becoming victims. The rules ensure that the Dynamic Political Hierarchy theory is applied logically and consistently to all agents. For example,

```
rule 'protest' becomes 'basic'
    condition "true"
    attribute 'Influence_level' "[Influence_level]-protest_influence"
    attribute 'angry' "angry"
    attribute 'prev_act' "activated([cache])"
```

This rule is applied when an agent decides to stop protesting in the model. The first line states that the agent is going to change from a ‘protest’ agent to a ‘basic’ agent. The condition “true” selects the ‘protest’ agent and reduces its high influence level to that of a basic agent. This is indicated by the subtraction of ‘protest_influence.’ The last two attributes do not change the functionality of protest. The angry attribute measures whether the agent has passed the “angry_trigger” and sets the agent attribute as ‘angry’ if it has passed the trigger. The ‘prev_act’ attribute measures the agent’s previous activated identity from the last time step.

4.5.6 GPM: Views

This section allows the researcher to view the model through different lenses. In this specific model, ‘admin1,’ ‘admin2,’ ‘admin3’ and ‘elite’ were created. As shown in Appendix D, E and F, the ‘admin1,’ ‘admin2’ and ‘admin3’ views show the geographical boundaries of

Pakistan mapped into the agent-based model. In addition, the ‘elite’ view conveniently highlights the influential agents and elite networks in the model.

4.5.7 GPM: Statistics

The statistics section of the GPM determines which elements are measured in the model. Statistics include the number of agents activated on every identity, the DPH level of each identity, the number of agents lobbying, protesting, and acting violently, the number of elites for specific identities and more. Any other information that the modeler wants to gather can be added here.

5. Experimenting with Operationalization

After building the model, a final script combines all of the different subscripts and creates a baseline model. The screen shot of Virtual Pakistan at $t=0$ can be seen in Figure 2. Figure 2 consists of 4,449 agents. Each square or agent represents a segment of the population. The color of each agent represents its activated identity. For example, an agent that is shaded teal represents the Punjabi identity and an agent that is shaded yellow represents the military identity. Each agent has a separate set of identities that they subscribe to, but are not activated on. For example, the agent activated on the Punjabi identity may also be a nationalist, support the military and practice Sunni Islam. Activated identities are important because they signify the primary identity that is driving an agent’s behavior at the time. Subscribed identities are important because as mentioned in the DPH section, they determine how connected or disconnected an agent feels to the society and may be relatively easily activated.

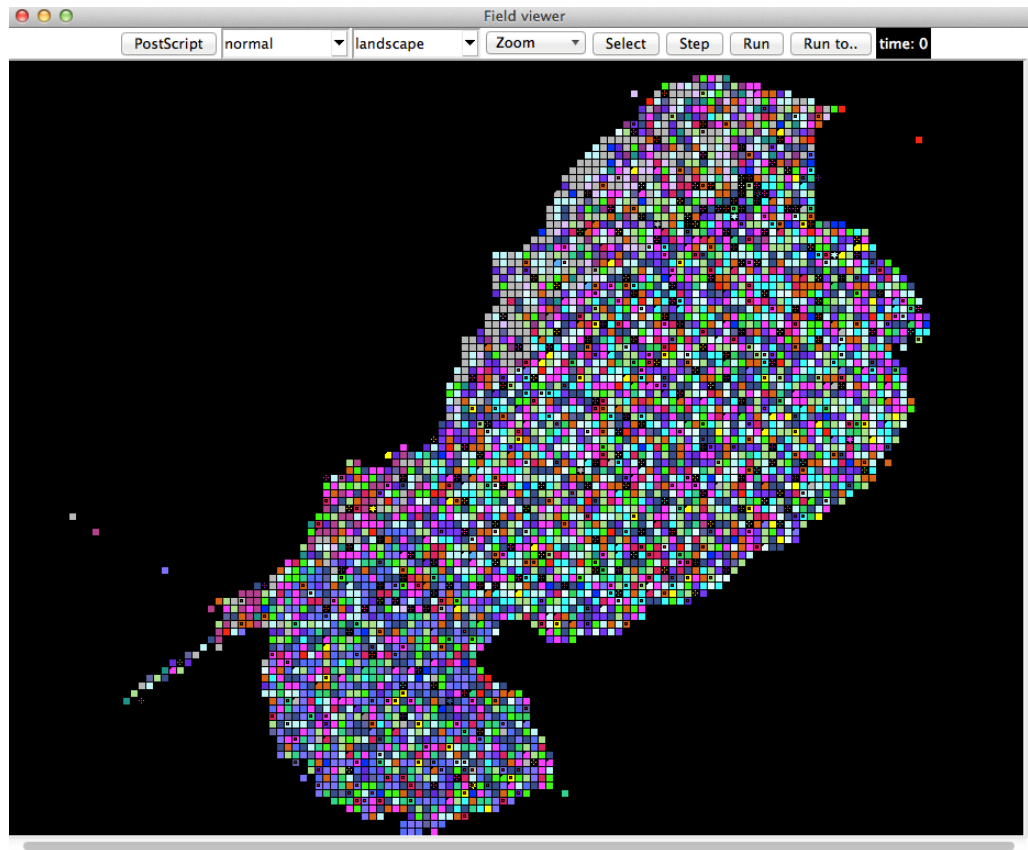


Figure 2 Snapshot of Virtual Pakistan at $t=0$

Running the model generates unique patterns of activated and subscribed identities, which represent trajectories of the nation. In this case, 500 distinct futures are produced. A “burn in period” of 40 time steps allows the trajectories to differ from one another. Every week I ran the baseline for 10-60 trajectories and wrote about the problems encountered and the alterations to the model.⁵⁵ In an attempt to increase transparency and demystify the agent-based modeling work, I included a log recording iterations and alterations made throughout the model building process.

⁵⁵ Complete Log: Appendix B

Experimentation Summary

Date	Problem after running baseline	Modification to Virtual Pakistan
10/2/12	Elite agents lack specialized repertoires	1. Seed influential agents with appropriate political, religious, ethnic and socioeconomic identities.
10/19/12	Influential E's has too many identities. For example, the most powerful agent in the model cannot have the Poor identity.	1. Manually changed the repertoire of influential E so that it has the ability to acquire the five identities that represent the five futures 2. Create a rule that allows the listening rules to change according to the identity activation of the Influential E
11/2/12	All runs show an Influential E activated on the same identity	1. Added a burn-in period 2. Added a script that would randomize activation every run
11/17/12	Nationalist identity dominating the landscape during every run No statistic revealing elite activation	1. Reduced the nationalist identity by multiplying each value by .3 2. Added a column to measure when elites were activated on the five most important identities
11/24	Nationalist identity continues to dominate the landscape during every run	1. Reduced the nationalist identity by .4
1/17	No problems encountered this iteration	1. Added socioeconomic identities – Poor, middle class and wealthy 2. Added religious elite network by giving some Sunni Muslims more influence than others
1/25	Sunni Muslim capped at 25% and is not allowing religious elite to play a role	1. Slightly increase Sunni Muslim percentage cap (thickness)
1/31	Final Version of Virtual Pakistan completed.	

After experimenting for months, the final baseline was complete. Virtual Pakistan's purpose is to test the likelihood and possibility of different scenarios suggested by the Council on Foreign Relations' (CFR) Pakistan Crisis Guide.⁵⁶ As mentioned earlier, the CFR study suggests

⁵⁶ Moran, M. (2011). Crisis Guide: Pakistan. Retrieved from

Pakistan could become a state adrift, experience a military coup, turn into a theocracy, become a moderately Islamic government or collapse altogether.

This experimentation section seeks to explain the operationalization of the five possible futures of Pakistan. This section summarizes the CFR's explanation of the five futures and then derives possible metrics of analysis using their definitions. The derivations are based solely on the information provided by the CFR's interactive website and exclude any outside definitions of the five futures found in political theory or elsewhere. As will be discussed later, trajectories that differ from the five futures outlined by the CFR will remain in an "other" category and will be analyzed as other possible futures excluded by the report.

Each of the following sections includes three ways of illustrating a particular type of future. The first method includes counting the number of identities activated on a specified identity; the second method involves counting the number of elites activated on that same identity; and the third technique requires observing the activation pattern of the influential E. In order to determine the correct method of operationalization, multiple experiments tested which of the methods of operationalization worked most effectively.⁵⁷

5.1 A State Adrift

The first future the Council on Foreign Relations suggests is "A State Adrift." Daniel Markey of the Council on Foreign Relations states that in this future, Pakistan will not see political reform, experience little economic growth and maintain contentious relations with India. Ashley Tellis, Shuja Nawaz and Kim Barker believe this is the most likely future for Pakistan. Steve Coll and Isabel Coleman dissent from their opinion. Ashley Tellis and Shuja Nawaz state that this is the dominant future for Pakistan in at least the next decade and possibly after based on

http://www.cfr.org/interactives/CG_Pakistan/index.html?cid=otc-marketinguse-pakistan_cg

⁵⁷ Appendix B

historical analysis. Shuja Nawaz rationalizes his prediction by stating that most of the well-intentioned leaders in the past have failed to make tough decisions and solve the nation's political and social problems. Kim Barker also argues this is the dominant outcome because Pakistan is still in "survival mode" with little to no plans to reform in the future. At this point, she claims that all civilian leaders are struggling to hold on to power. Only one scholar, Steve Coll, disagrees as he claims that the status quo is unlikely to continue because the Indian government will not allow this and because the United States will soon transition out of Afghanistan. He claims these two external influences will push the country to reform. Isabel Coleman remains on the fence about the likelihood of this future, claiming that Pakistan might continue on this path, but it could change if there was something that forced it to alter its status quo.⁵⁸

A state adrift can be measured in the agent-based model using concrete rules. The first way to code this trajectory is through examining the pervasiveness of the identity of the current dominant political party, the Pakistan People's Party (PPP) as Shuja Nawaz and Kim Barker believe that the current people in power will continue to remain there. Thus, if the PPP dominates the landscape, this will imply that the masses are electing the same officials and thus the state is not changing its policies. The second way to measure this future is to examine the pervasiveness of the state identity. The state identity represents people who are satisfied with the central government in its current form. Another way to measure this future is by examining the number of elites that will continue to support PPP. Lastly, one can examine the identity activation of the most powerful agent in the landscape "Influential E." If Pakistan continues its weak and ineffective policies, this could mean that its President has ties with those political

⁵⁸ Moran, Video Clip "A State Adrift"

parties who have historically had similar policies. Thus, if the influential E is activated on the PPP identity, this signifies that it is continuing its historical trend.

5.2 A Military Coup

The CFR study defines an authoritarian state as “one in which the military leadership of Pakistan reasserts its control over institutions, and in order to do so it feels it needs to use more repressive measures to quell dissent; in the process, it may form alliances with Islamist parties as a means to work against opposition forces and to keep control over a state that in the past has shown the military is difficult to have a firm grip on.”⁵⁹ All of the scholars agree that at the present state, it is unlikely that the military will take over; however, they are not ruling out this possibility. Scholars Steve Coll, Christine Fair, Howard Schaeffer and Isabel Coleman each see this as a possible future. Steve Coll believes this is possible because military coups have occurred three times already in Pakistan’s history. Although the military insists that they are going to remain in the background for the time being, it is possible that they could take over if they see a crisis situation. Scholar Christine Fair believes this is a possible future because every time the military asserts control over the civilian institutions, they “hollow out” civil institutions making it easier for the military to intervene again. Ambassador Howard Schaffer is also concerned about this future and sees it as a possibility as he states the civilian government’s current lack of presence and fragility of institutions allows for such a military role. Council on Foreign Relations Scholar Isabel Coleman claims that while this future is possible, the military class of Pakistan today is more moderate than it has been in previous cases during General Zia-ul-Haq’s regime.⁶⁰

⁵⁹ Council on Foreign Relations. (2011). *An Authoritarian State* [Video file]. Retrieved from http://www.cfr.org/interactives/CG_Pakistan/index.html?cid=otc-marketinguse-pakistan_cg#/five-possible-futures/

⁶⁰ Council on Foreign Relations. (2011). *An Authoritarian State* [Video file]. Retrieved from

A military coup can be operationalized in the model in three different ways. One way to code a military coup is to examine how many agents are activated on the military identity. If the military identity dominates the landscape, this signifies that many people in the country sympathize with or are choosing to align with the military identity and thus the military could usurp power. Another way to measure a military coup is through examining the number of elites activated on the military identity. A high number of military, political and business elites activated on the military identity signify that the military officials and supporters are penetrating national institutions. A third way to measure a military coup in the model is through examining the activated identity of the influential E. If the influential E adopts a military identity, this signifies that the highest elite in the nation associates with the military over any other identity that it could have in its repertoire.

5.3 An Islamist Government

The CFR study also examined the possibility of an Islamist government taking over in Pakistan. They claim that in this scenario, Pakistan “veers more radically towards extreme ideologies, where the leadership chooses to embrace Islamic attitudes, policies and views that change the strategic outlook in the region.” It could also consist of an Islamist party dominating the nation or as a replacement to traditional military and civilian structures of governance in Pakistan. None of the scholars interviewed in the Council on Foreign Relations saw this future as a probable outcome; however, they described what this scenario entails. Isabel Coleman claims that Pakistan has already seen this scenario under Zia-ul-Haq and that it is unlikely that this will occur again. Reza Aslan claims that this future is an impossible scenario of Pakistan because the military is in charge of Pakistan at the core, they will never let nuclear weapons fall into the

http://www.cfr.org/interactives/CG_Pakistan/index.html?cid=otc-marketinguse-pakistan_cg#/five-possible-futures/

hands of Jihadists. Howard Schaeffer claims this is unlikely because no Islamist party has ever won or could possibly win through democratic elections. Shuja Nawaz claims that this is unlikely because there is only a small portion of the government that follows extremist ideologies and most people in the nation veer towards Sufi or Salafi Islam. Steve Coll says it's difficult to imagine this future because of cultural, tribal and political forces disrupting the country.⁶¹ Thus no scholar believes this is a likely future.

An Islamist government can be operationalized in the model in three ways. The first technique is by counting the number of agents activated on the Jihadi identity. In this case, the Jihadi identity will represent an Islamist government because it represents those Muslims who explicitly stated in survey data that they sympathize with religious extremist groups. Thus, this identity's dominance will represent this future more accurately than any other Muslim identity. Another way to measure this future is to examine the number of elites activated on the Jihadi identity. High numbers of elites activated on the Jihadi identity signifies penetration of the government institutions by those who associate with extremism. A third way to measure this future is to examine the identity activation of the influential E and measure how frequently the agent is activated on the Jihadi identity.

5.4 A Moderate Government

Daniel Markey of the Council on Foreign Relations defines “a moderate government” as a Pakistan that “pursues some gradual improvements in the quality of its governance, its opening to the world, its relationship with India and finds a stable balance with civilian and military in charge of the county.” The CFR study expresses the opinion of six scholars, three of whom see this outcome as possible and likely and another three who disagree with the feasibility of this

⁶¹ Council on Foreign Relations. (2011). *An Islamist State* [Video file]. Retrieved from http://www.cfr.org/interactives/CG_Pakistan/index.html?cid=otc-marketinguse-pakistan_cg#/five-possible-futures/

outcome. Shahid Burki, Isabel Coleman and Shuja Nawaz believe that this is a feasible outcome for a variety of reasons. They claim that Pakistan has hit rock bottom and can only go up at this point and that at some point terrorism will become less prevalent. They also believe that external actors such as the US, India and China want this future to occur, and lastly they claim that Pakistan's growing middle class consists of 30 million people which could be mustered to create a political or economic movement for better. Scholars Daniel Markey, Christine Fair and Hassan Abbas disagree with Burki, Coleman and Nawaz's optimism. They claim that the poor quality of education, lack of economic opportunities and the institutions of state indicate that Pakistan is less likely to follow this trajectory. They also claim that this future requires 10-15 years of economic growth and stability and a change in the mindset of India.⁶²

A moderate state can be operationalized in three ways. The first way of operationalizing a moderate state is through counting the number of agents activated on the nationalist identity. The second technique is to measure the number of elite activated on the nationalist identity. The third technique is to measure the identity activation of the Influential E. If the influential E activates on the nationalist identity, this will symbolize that Pakistan has found a leader who puts the interest of the nation before everything else.

5.5 A Collapsed State

The fifth future suggested by the CFR study is a collapsed state. In this case, "the state and its institutions are no longer capable of responding to internal or external conflicts." Scholars Reza Aslan, Isabel Coleman, Arpitha Bykere, Kim Barker, Christine Fair and Steve Coll see this is an unlikely scenario. Dr. Arpitha Bykere, a senior analyst at the Ruobini Global Economics,

⁶² Council on Foreign Relations. (2011). *A Moderate State* [Video file]. Retrieved from http://www.cfr.org/interactives/CG_Pakistan/index.html?cid=otc-marketinguse-pakistan_cg#/five-possible-futures/

claims that economic unrest and political unrest could lead to a situation where the government cannot handle the burdens and has no other choice. Kim Barker and Christine Fair claim that this is unlikely because of the strong influence of the army and that in order for the state to collapse, the army would have to collapse first. Steve Coll believes that external influences will most likely ensure that Pakistan stays together because there is a lot at stake for the international community. Daniel Markey states that the state could collapse if Pakistan's "islands of instability" or "no-go areas for the army" grow.⁶³

The fifth future can be operationalized in three possible ways. Because this future requires the complete break down of institutions, it is the most difficult future for Pakistan. For this reason, a few things need to happen simultaneously for this to count as secession. The first way to operationalize this future is to examine the prominence of the Punjabi identity. Because the Punjabi is the most dominant province in Pakistan, the country is reliant on this province holding the country together. If the Punjabi identity becomes too dominant, one could assume that Punjabis no longer feel that they can connect with the rest of the country. Thus, the collapsed state occurs when the Punjabi identity becomes dominant and the state identity weakens. The second way to operationalize this future is to examine how frequently elites activated on the Punjabi identity. The third way to measure this future is to examine how frequently the Influential E is activated on the Punjabi identity.

⁶³ Council on Foreign Relations. (2011). *A Collapsed State* [Video file]. Retrieved from http://www.cfr.org/interactives/CG_Pakistan/index.html?cid=otc-marketinguse-pakistan_cg#/five-possible-futures/

6. Analyzing the Results

As explained above, I used the CFR explanations to determine which metrics would best operationalize the five futures. Based on the CFR's definition of the five futures, the following metrics were used when calculating the likelihood of the five futures:

Future	Operationalization of each future (Between time steps 41-100)
State Adrift	1. Frequency of PPP/ State dominance 2. Elite Activation on the PPP 3. Influential E PPP activation frequency
Military Coups	1. Frequency of Military dominance (DPH) 2. Elite activation on the military identity 3. Influential E Military activation frequency
Moderate	1. Frequency of Nationalist and/or middle class dominance 2. Elite Activation on the Nationalist identity 3. Influential E Nationalist activation frequency
Islamist Government	1. Frequency of the Jihadi dominance 2. Elite Activation on the Jihadi identity 3. Influential E Jihadi activation frequency
Collapsed Government	1. Frequency of the Punjabi identity and less than .01% activation on state identity 2. Elite Activation on the Punjabi or Pashtun identity 3. Influential E Punjabi activation frequency

After running the model for 500 trials, the following data revealed the frequency of each of the five futures. Each run lasted for 100 time steps, providing agents with 100 opportunities to change activated and subscribed identities.

Figure 3 shows the frequency of each future according to specific identity activation. The y-axis represents the number of times each future was dominant at the end of a trial. The PPP or state identities need to dominate the landscape in order to code the trial as a state adrift. The nationalist identity needs to dominate the landscape in order to code the trial as a moderate state. The military identity, Jihadi identity and the ethnic identities need to dominate the landscape for

a military coup, Islamic government and collapsed state respectively. The “other” category refers to those futures that did not fit neatly into one of the categories prescribed by the CFR.

As shown below, Pakistan remaining adrift is the dominant outcome when measuring the identity activation. Approximately 275 out of 500 times, PPP or the state identity dominated the landscape. After a state adrift, a moderate state occurred most frequently with roughly 112 futures experiencing this outcome. Military rule, Islamist governance and a collapsed state appear less frequently than the other two futures as they occurred less than 25 out of 500 runs. The “other” future occurs roughly 10% of the time. However, the other future could be any other trajectory in which an unexpected identity, such as business or Shia, dominates the landscape.

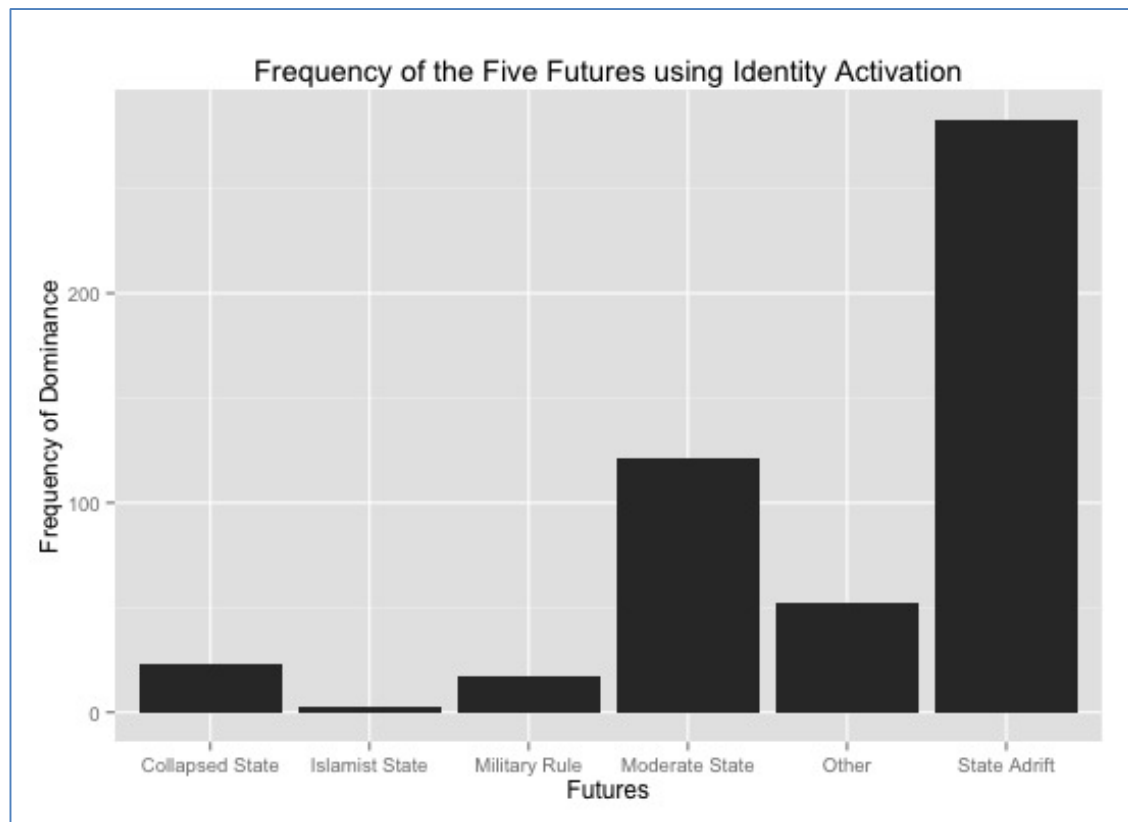


Figure 3 Bar graph showing the frequency of the five futures presented by the CFR by measuring Identity Activation

Figure 4 shows another way to measure the frequency of the five futures by measuring the number of elite agents in the model that are activated on the identities mentioned. As explained earlier, elite agents are those agents that have higher influence levels built into their rules. There are 15 different types of elite agents - InfluentialsA through E representing military, political and business elites. The aggregate influence for all of the elites in the model is 2065. Aggregate influence refers to the collective influence that an identity can have in the model; thus, the aggregate influence is not how many elite agents are activated on an identity, but rather the aggregate influence level.

The box and whisker plot shows that more frequently than any of the other futures, a moderate state occurs. Box and whisker plots depict numerical data by providing five number summaries: the smallest observation, the lower quartile, the median, the upper quartile and the largest observation. The two edges of the box illustrate the lower and upper quartile, while the middle line represents the median. The lines outside of the box show the smallest observation and the largest observation.

In this case, the moderate state maintains the highest upper quartile and median value, signifying that that elite activation on the nationalist identity occurs more frequently than any of the other identity. The nationalist identity also has the largest range of elite activation. According to this graph, in some cases almost half of the elites are subscribed to the military and state identity, however, the majority of the time, this is not the case. Elites are also infrequently activated on their provincial identities. This particular graph, measuring the provincial elites reveals less about the futures because the graph is missing the geographical location. It is possible that the political and military elites activated on the Punjabi identity are located in the Punjab province. Such information would reveal ethnic pride rather than a prominence of a

collapsed future. While there were some outliers, the majority of the elites were not subscribed to the jihadi identity. Overall, the graph reveals that the elites see it in their interest to promote their nationalist identity rather than any of their other identities

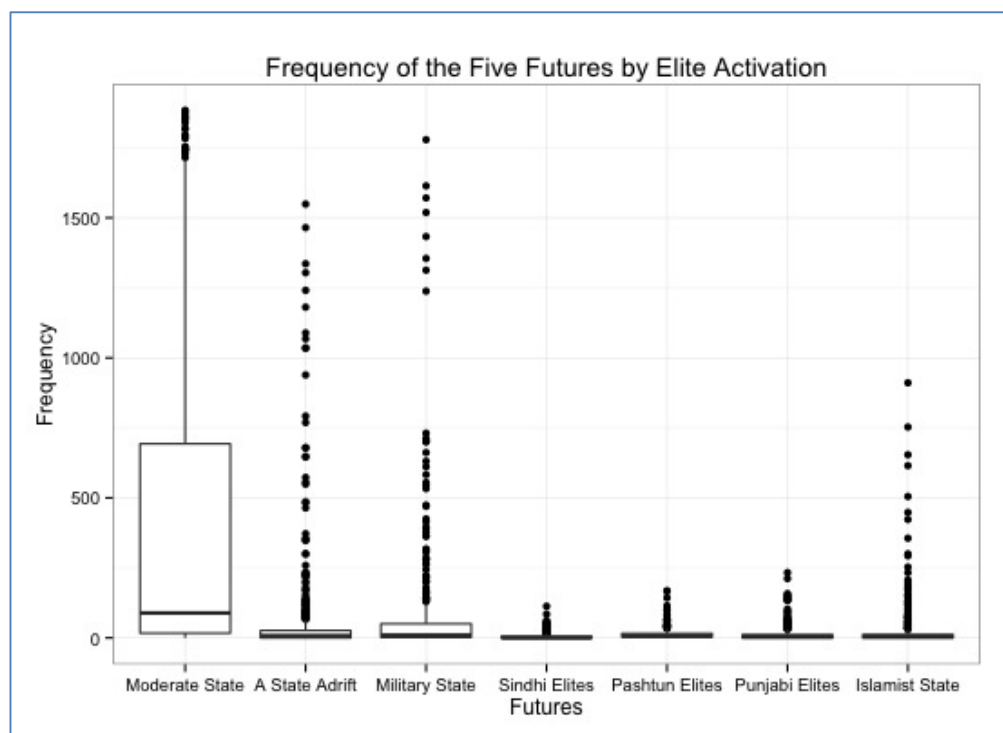


Figure 4 Box and Whisker plot with the frequency of the five futures by elite activation

Figure 5 illustrates the frequency of the five futures by measuring how often the dominant identity and the influential E agent, the most powerful agent in the landscape, are in sync. This graph is important because as explained in the DPH section, the dominant identity represents the sentiments of the masses and the influential E identity represents the sentiments of the President or Prime Minister. If the masses and the leader are activated on different identities, this could signify that the leader is passing policies inconsistent with the desires of the masses and that the masses are discontent. The mosaic graph, Figure 5, reveals that the state identity is the most dominant and powerful identity more frequently than any of the other identities. The nationalist identity also experiences this monopolization of power. However, for most of the

identities there is little to zero synchronization between the dominant identity and influential E agent. In this graph, the x-axis represents all of the dominant identities and y-axis represents all of the identities that Influential E could activate on. The light blue box signifies that the dominant identity and Influential E's identity overlapped many times. The dark blue boxes signify that the identities overlapped sometimes and the white boxes signify that the influential E and the dominant identity never overlapped.

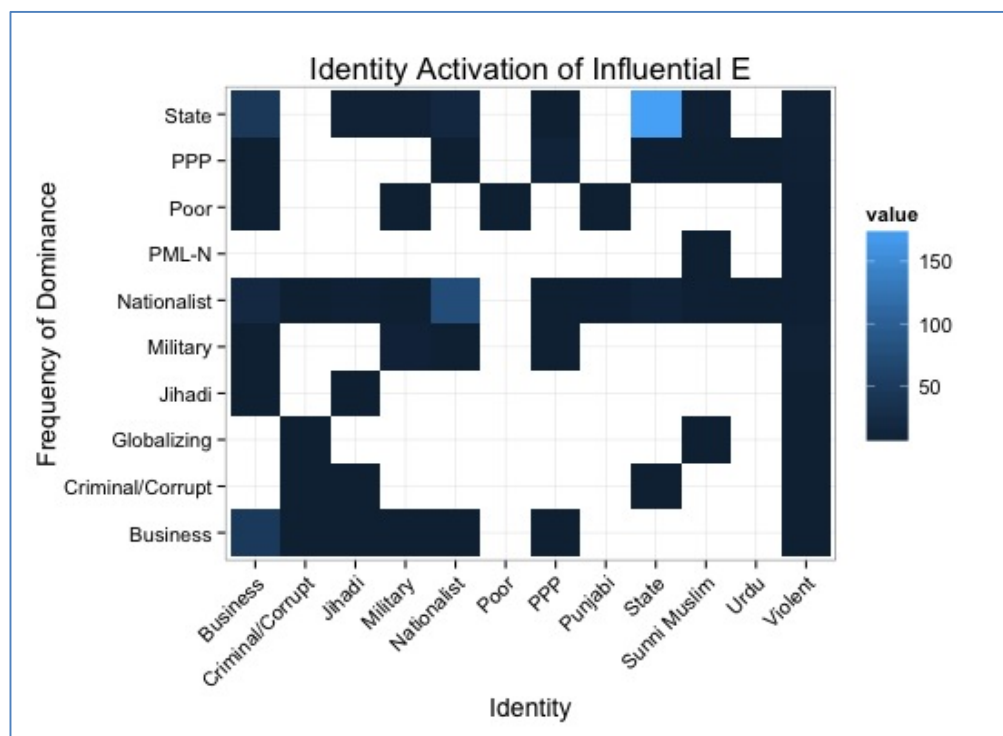


Figure 5 Mosaic graph showing how frequently the most powerful agent on the landscape (Influential E) overlaps with the dominant identity

6.1 Results: A State Adrift

The data above reveal information about the frequency of the state adrift future. As discussed above, Figure 3 reveals that the PPP and state identities dominate the landscape more frequently than any other identity in the model. A state adrift occurs in the model nearly twice as often as the second most frequent future. Figure 4 reveals that most of the elites were activated on the nationalist identity, but a small percentage of the elites were activated on the PPP identity.

On average, 3.34% of the elite agents were activated on the PPP identity. Other statistics about elite activated on PPP identity include median = .3874%, the 1st Quartile = 0% and 3rd Quartile =1.743%. This information reveals two important findings; first, the basic agents were more likely to activate on the PPP and state identity than the elite agents. Second, the model should have measured the percentage of elites activated on the state identity to compare the difference between those activated on the state identity and those activated on the PPP identity.

While Figures 3 and 4 provide two different metrics through which one could measure the likelihood of Pakistan's future, they do not account for the overlap between the two metrics. Figure 7 shows that on average, when the majority of people supported the PPP, about 25% of the elites were activated on the PPP identity. In some cases, this number reached 50% or higher. When the other identities were dominant, fewer elites activated on the PPP elites.

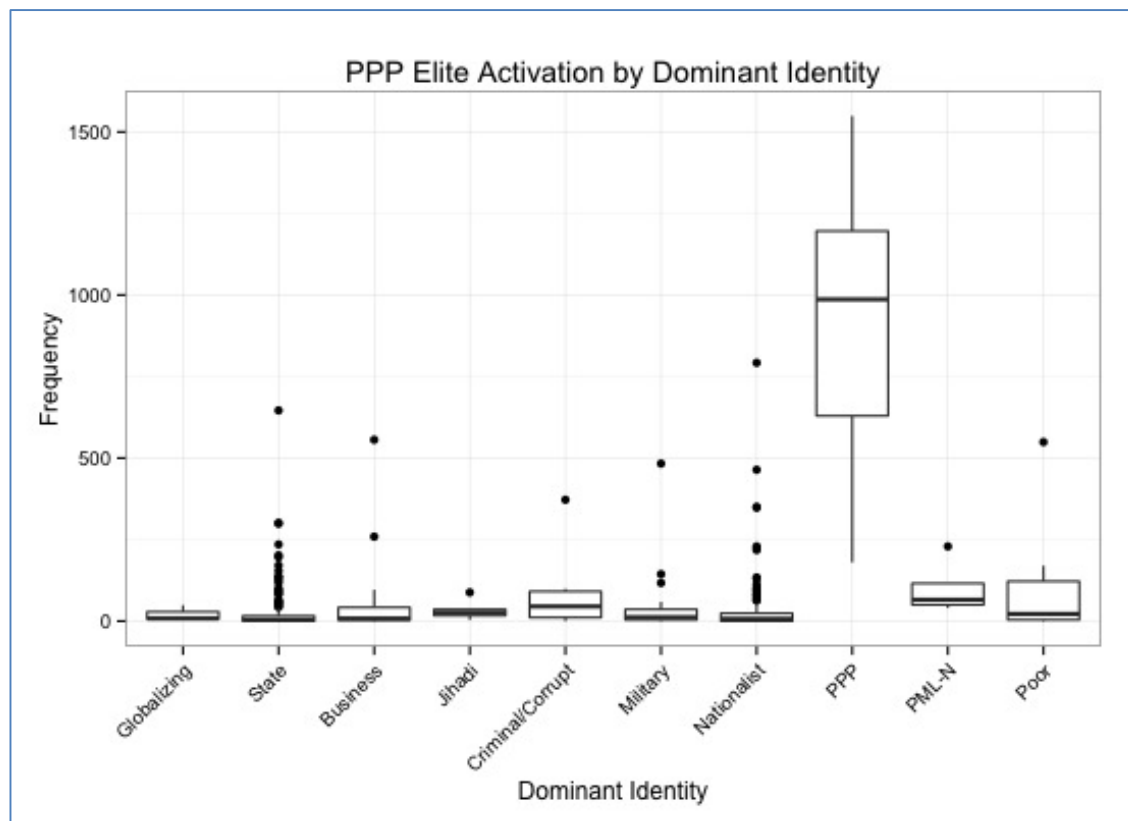


Figure 7 Box and whisker plot showing how many elites are activated on PPP when different identities are dominant

The data from the simulation also reveals that Influential E was activated on the state and PPP identity 37.19% of the time.

All of these graphs and screenshots suggest that when the PPP is in power, large segments of the population support their presence. Intuitively, this conclusion makes sense because it suggests that when members of the PPP are in power, Pakistani citizens have voted them into office. When Pakistanis vote members of this party into office, this indicates that Pakistan will continue with the status quo. For example, in 2008, Pakistanis elected President Asif Ali Zardari to serve as the President of the country and little has changed under his leadership.⁶⁴ Although the country had experienced PPP leadership under Benazir Bhutto and Zulfiqar Ali Bhutto, Asif Ali Zardari had never previously served as the country's President. However, he continued the same patterns of governance of previous PPP leaders. During his Presidency, Pakistan lacked any major political reforms, experienced an energy crisis, saw no improvement in economic conditions, health care, education and did not establish any long-term vision for the nation.⁶⁵

Although PPP's past ineffectiveness does not guarantee a future of ineffective policies, there are no signs of party reformation. In December 2012, the Pakistani People's Party announced that Bilawal Zardari-Bhutto, Benazir Bhutto and Asif Ali Zardari's son, was the new party chairman.⁶⁶ If Bilawal comes to power at any point in the future, he will continue PPP's tradition of hereditary political dynasties. These dynasties have proven strong despite their

⁶⁴ Birsal, R. (2008, September 6). Zardari wins Pakistan election. *Reuters*. <http://www.reuters.com/article/2008/09/06/us-pakistan-election-idUSSP17223420080906>

⁶⁵ Riedel, B. (2013, January 4). Battle for the Soul of Pakistan. *India Today*. <http://www.brookings.edu/research/opinions/2013/01/04-pakistan-riedel>

⁶⁶ Riedel, B. (2012, December 29). Pakistan's Impossible Year: Elections, Army Intrigue, and More. *The Daily Beast*. <http://www.brookings.edu/research/opinions/2012/12/29-pakistan-riedel>

“repeated failures in government, repeated failures to deliver on promises to the masses and in many cases, the abandonment of whatever genuine ideology they ever possessed.”⁶⁷ Thus, if Pakistanis elect PPP officials again, they are likely to experience the same weak patterns of governance.

As mentioned above, Pakistan experts believe that this future is most likely to continue because it has been Pakistan’s dominant future during its 65-year history. The model complements the qualitative data by revealing the frequency of this scenario. The model goes one step further as it allows a researcher to visualize slight differences within this scenario. The following screenshots show different ways a state adrift could unfold in Pakistan.

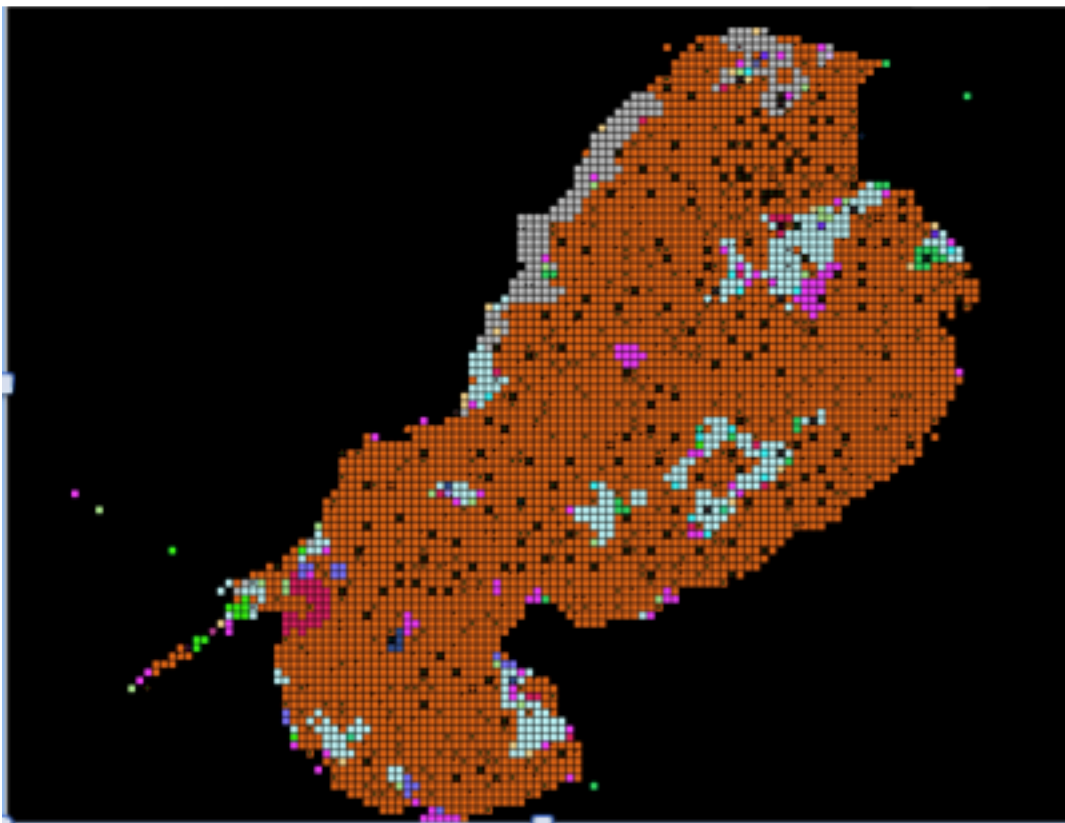


Figure 8: A screenshot of the model at $t=100$ in which the state identity dominates the landscape.

⁶⁷ Lieven, 234-235

The version of “A State Adrift” in Figure 8 reveals that the state identity, shown in orange, dominates the landscape throughout most of the country except in Pakistan’s Federally Administered Tribal Areas and Balochistan. The state identity in this case signifies support for the current government, which is PPP. FATA’s lack of support for the state identity signifies that people in that region still feel alienated from the rest of the nation. It also suggests that under this future, FATA will remain an autonomous unit separate from the federal government. As mentioned early, scholars believe that as long as FATA feels alienated from the nation, the country will continue to experience violence⁶⁸ and have trouble creating a national identity. This model also reveals that people residing in Balochistan lack any connection to the state identity. Such alienation of Balochistan reflects the status quo as Balochistan has experienced the most violence from sectarian groups in the past few months and received little to no support from the current government.⁶⁹

⁶⁸ Cohen, S. P. (2011). *The Future of Pakistan*. Washington, DC: Brookings Institution.

⁶⁹ Siddiqi, A. (2013, January 14). Analysis: Violence against Hazaras in Balochistan. *The Express Tribune*. <http://tribune.com.pk/story/493645/analysis-violence-against-hazaras-in-balochistan/>

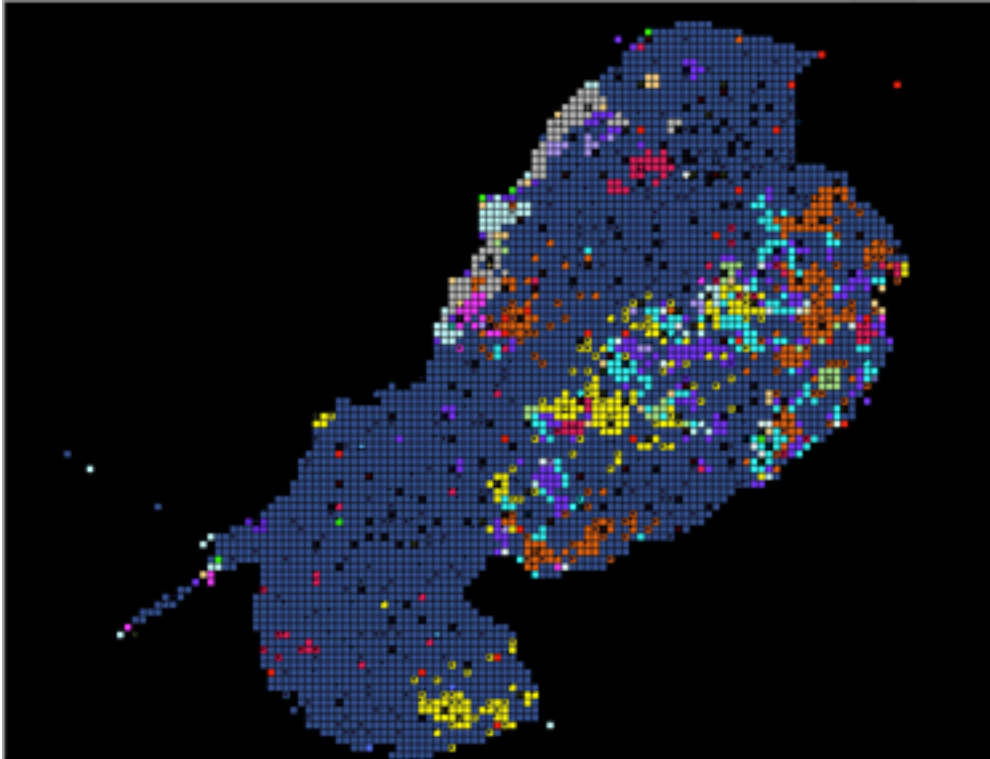


Figure 9: A screenshot of Virtual Pakistan when PPP dominates the landscape on the way to $t=100$.

Another version of “A State Adrift” can be seen in Figure 9. In this case, the dark blue signifies that the PPP identity dominates the landscape on the way to $t=100$. As mentioned earlier, the PPP represents a version of Pakistan that adheres to traditional methods of politics in which nation-building efforts are ultimately ignored and severe problems remain unsolved.

6.2 Results: A Military Coup

As mentioned above, the military identity dominates the landscape in less than 25 out of 500 runs. This frequency is less than that of the moderate, state adrift and non-categorized futures. However, the future occurs more frequently than a collapsed state or an Islamist state. Figure 4 reveals that most of the elites were activated on the state and nationalist identities and a small percentage of the elites also associated with the military. On average, .0375% of the elite agents were activated on the military identity. Other statistics about the relationship include median = .58%, the 1st Quartile = .7% and the 3rd Quartile = 2.7%. Thus, elites were very

infrequently activated on the military identity. The two graphs reveal that people less frequently identify with the military identity than with other identities in their repertoire. Furthermore, the entire nation will rarely unite under the military identity. The rarity of the military identity among the elites and the common people suggests that people no longer desire military interventions. Although it may seem obvious that people would not want military interventions, it is important to note that all of Pakistan's previous coups have had the support of the masses.

While Figures 3 and 4 provide two different metrics through which one could measure the likelihood of a military coup, they do not account for the overlap between the two metrics. Figure 10 shows that on average, when the majority of people supported the military, about 25% of the elites were activated on the military identity. In some cases, this number reached 60% or higher. When the other identities were dominant, there are little to no elites who openly supported the military identity.

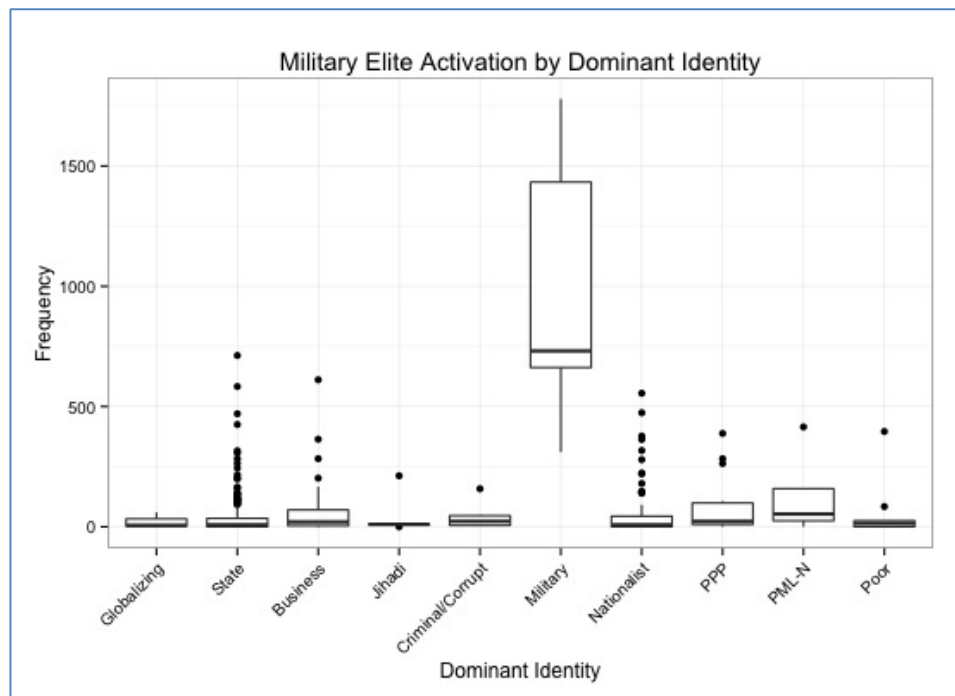


Figure 10: Box and whisker plot showing how many elites are activated on military when different identities are dominant

The data reveals that the Influential E is activated on the military identity 4.43% of the time.

All of these graphs suggest that a military coup occurs less frequently than some of the other futures. The CFR report suggests that this future is possible, but not necessarily probable. The data from the model complements this conclusion by showing similar findings. In Pakistan, people support the military as an institution but they do not believe that the military should intervene in political situations.⁷⁰ Without public support, it is unlikely that the military will take action against the government.

Pakistan completed its first civilian government term without military intervention, in its 65-year history, on March 16, 2013.⁷¹ Such information suggests that Pakistan may be shifting away from a nation with weak civilian institutions and military interventions. However, this could also be a temporary phase in Pakistan's narrative. History suggests that the military usually intervenes at 10-year intervals; thus, it is possible that Pakistan is in the middle of this interval and only at this current moment, a military coup appears unlikely. It is in the military's interest to be in power and direct Pakistan's budget towards defense spending. Although there are a number of questions that remain unanswered, it appears unlikely that Pakistan will experience a military coup in the short term.

⁷⁰ Fair, C., Ramsay, C., & Kull, S. (2007). Pakistani Public Opinion on Democracy, Islamist Militancy, and Relations with the U.S. *United States Institute of Peace Working Paper*, 1-44.

⁷¹ Al Jazeera and Agencies. (2013, March 17). Pakistan government completes full term. *Al Jazeera*. http://www.aljazeera.com/video/asia/2013/03/2013316193951188553.html?utm_content=automate&utm_campaign=Trail6&utm_source=NewSocialFlow&utm_term=plustweets&utm_medium=MasterAccount

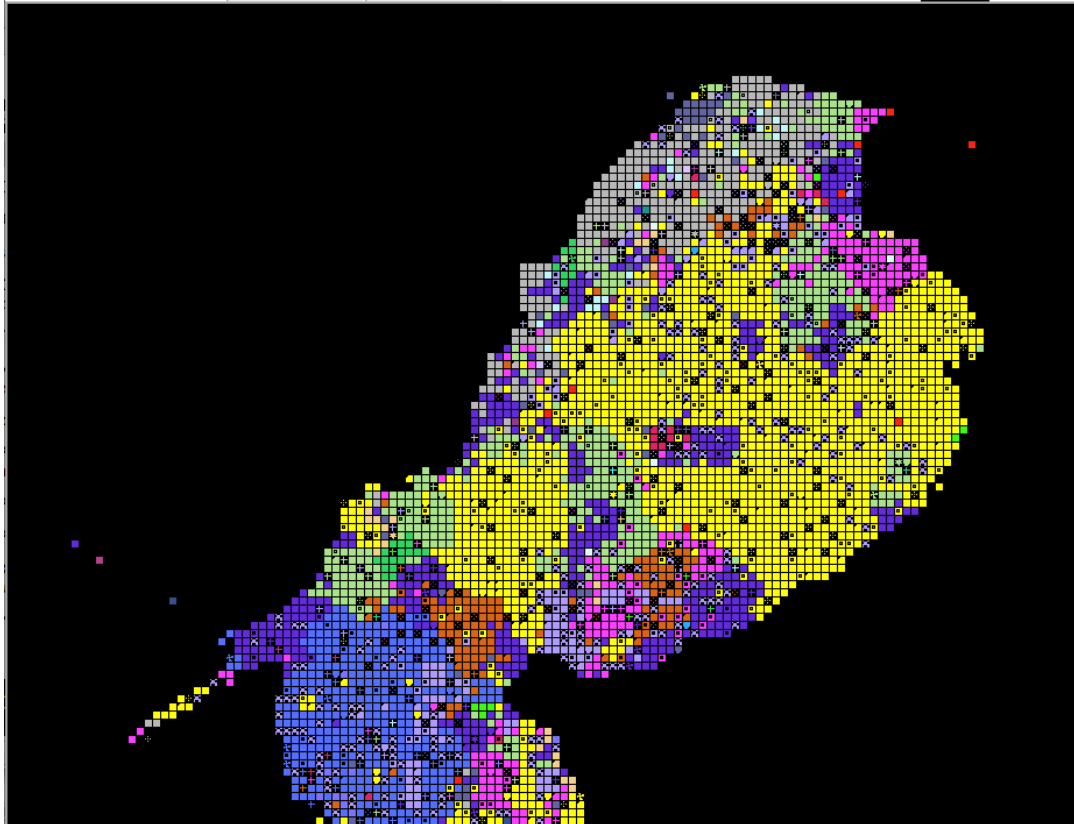


Figure 11 Screenshot of Pakistan experiencing a military coup on the way to $t=100$

Figure 11 shows an example of Pakistan experiencing a military coup. Although people maintain other identities in different parts of Pakistan, the majority of the Punjab province remains “yellow,” signifying it is receiving tremendous support in that region. Interestingly, other parts of Pakistan do not share Punjab’s sentiments, as PPP remains the dominant identity in Sindh and Jihadi in Balochistan.

6.3 Results: An Islamist State

Figure 3 reveals that the Jihadi identity dominates the landscape less frequently than all of the five futures with the exception of the collapsed state. Out of 500 runs, the Islamist future occurred less than 15 times. Figure 4 reveals that very few elites were activated on the Jihadi identity. On average, .01% of the elites were activated on the Jihadi identity. This signifies the difficulty that an elite would have associating with the Jihadi identity.

Figure 12 shows that on average, more elites were activated on the Jihadi identity. When the other identities were dominant, there are fewer Jihadi elites. The data reveals that the Influential E is activated on the Jihadi Identity in 2.24% of the futures.

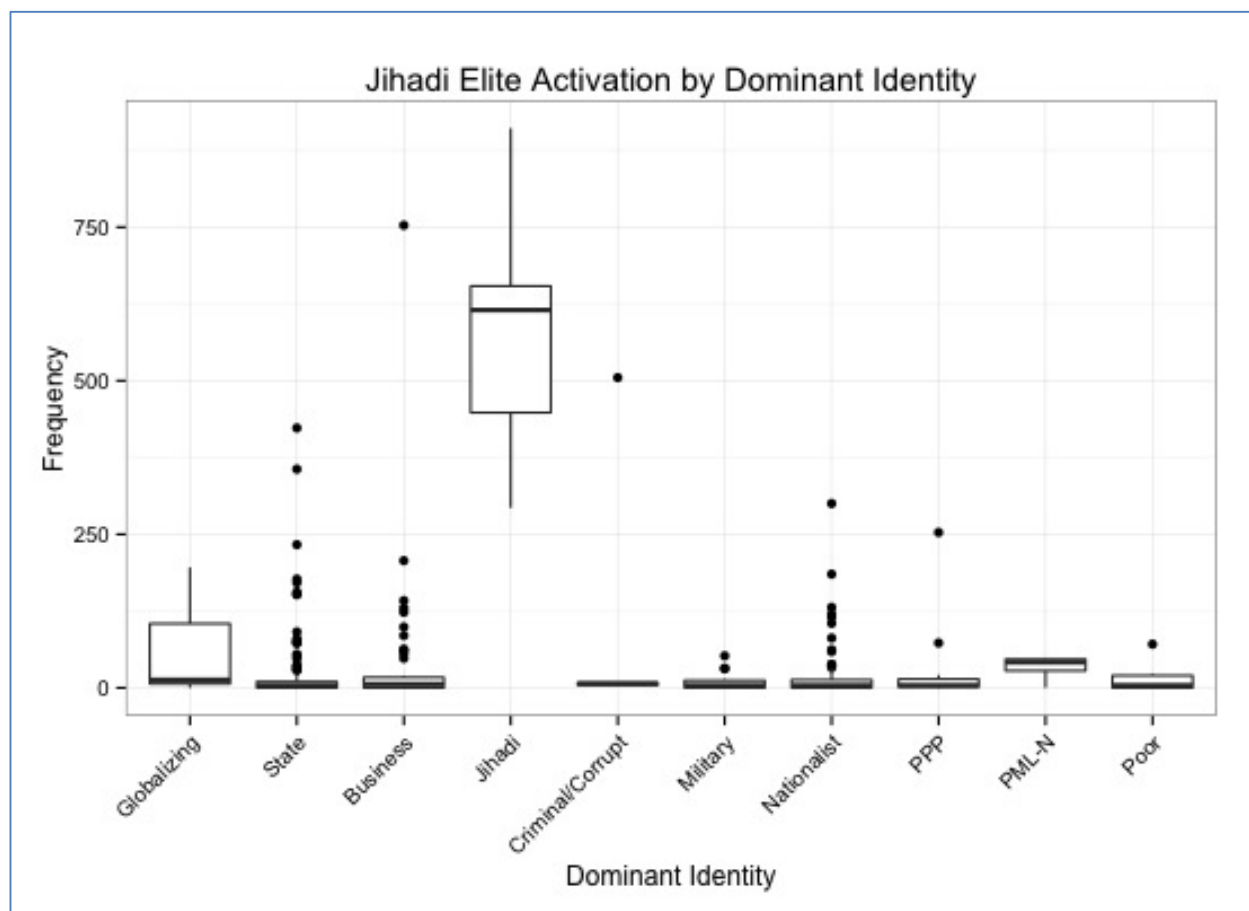


Figure 12 Box and whisker plot showing how many elites are activated on Jihadi when different identities are dominant

All of the graphs reveal the unlikelihood of Pakistan experiencing some type of Islamic take over. This does not mean that it is impossible, but it does suggest that it would be more difficult for Pakistan to veer towards this trajectory. While there are people who support Islamic groups, the vast majority of the citizens prefer peace to an Islamic government that could possibly increase the amount of violence in the country. As discussed earlier in this paper, there

are several ways such an outcome could occur. However, the lack of cohesion of the different Islamic groups suggests that it would be difficult for such a unified effort to occur.

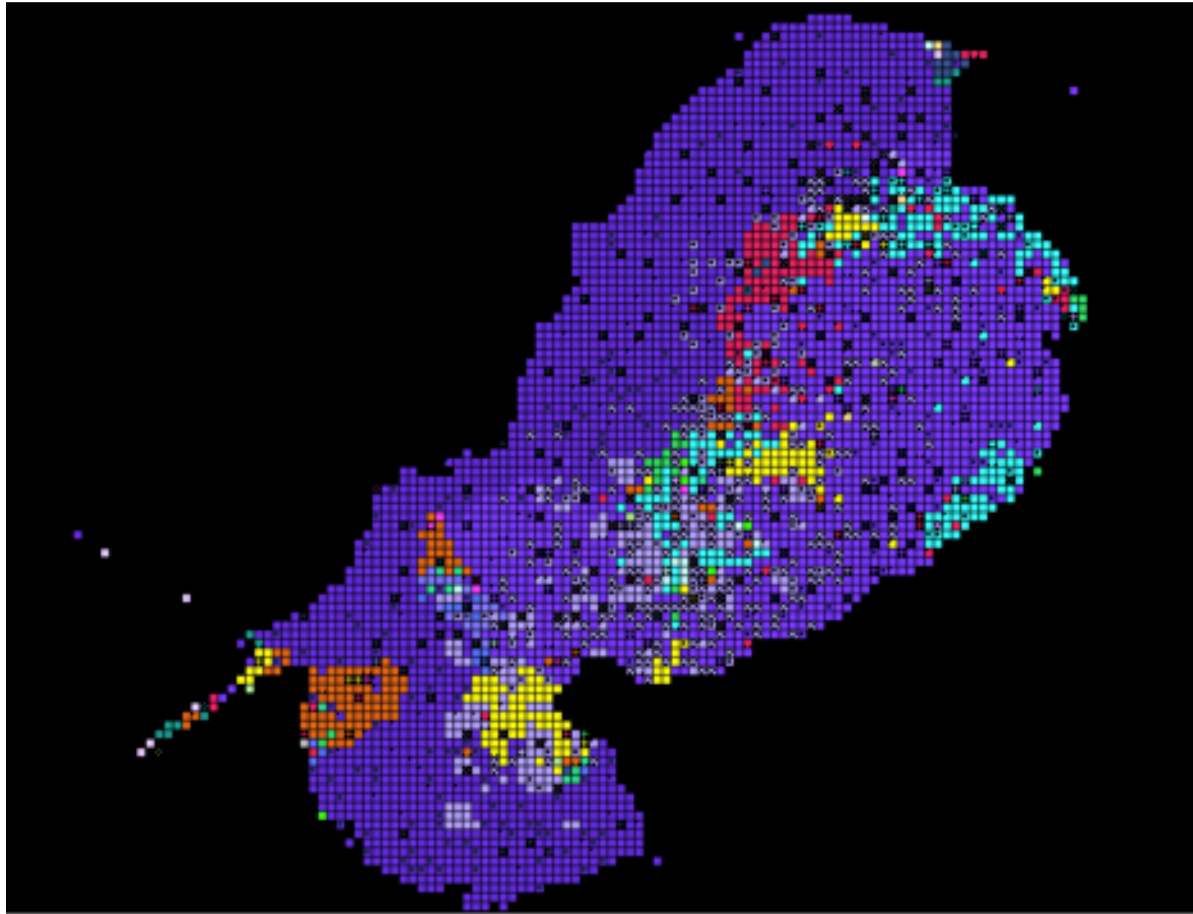


Figure 13: Screenshot of Pakistan experiencing an Islamist state on the way to $t=100$

Figure 13 provides an example of when the Jihadi identity dominates the landscape. In this case, the dark purple represents the Jihadi identity and represents those people who sympathize with the Islamist cause. As shown by the yellow (military) and orange (state) identities, there are certain segments of the population that do not sympathize with the Jihadi cause. They are, however, surrounded by agents who do support the cause.

6.4 Results: The Moderate State

The fourth future suggested by the CFR was a moderate state. Figure 3 suggests that this is the second most frequent future after a state adrift. Out of 500 futures, this future occurred

around 130 times. Figure 4 suggests that more often than any other identity, elites were activated on the nationalist identity. On average, 18.74% of the elites were activated on the nationalist identity at any given time step. The box and whisker plot shows that the median = 4.02%, 1st Quartile = .77%, 3rd Quartile = 24.87%. In one future, 91.7% of the elites were activated on the nationalist identity.

Figure 14 shows that when the nationalist identity is the dominant identity, on average, 1000 to 1600 elite agents were also activated on the nationalist identity. This graph reveals that more often than any of the other futures, elite agents and basic agents are both activated on the nationalist identity. In addition to this graph, the data reveals that the Influential E is activated on the nationalist identity 16.86% of the time.

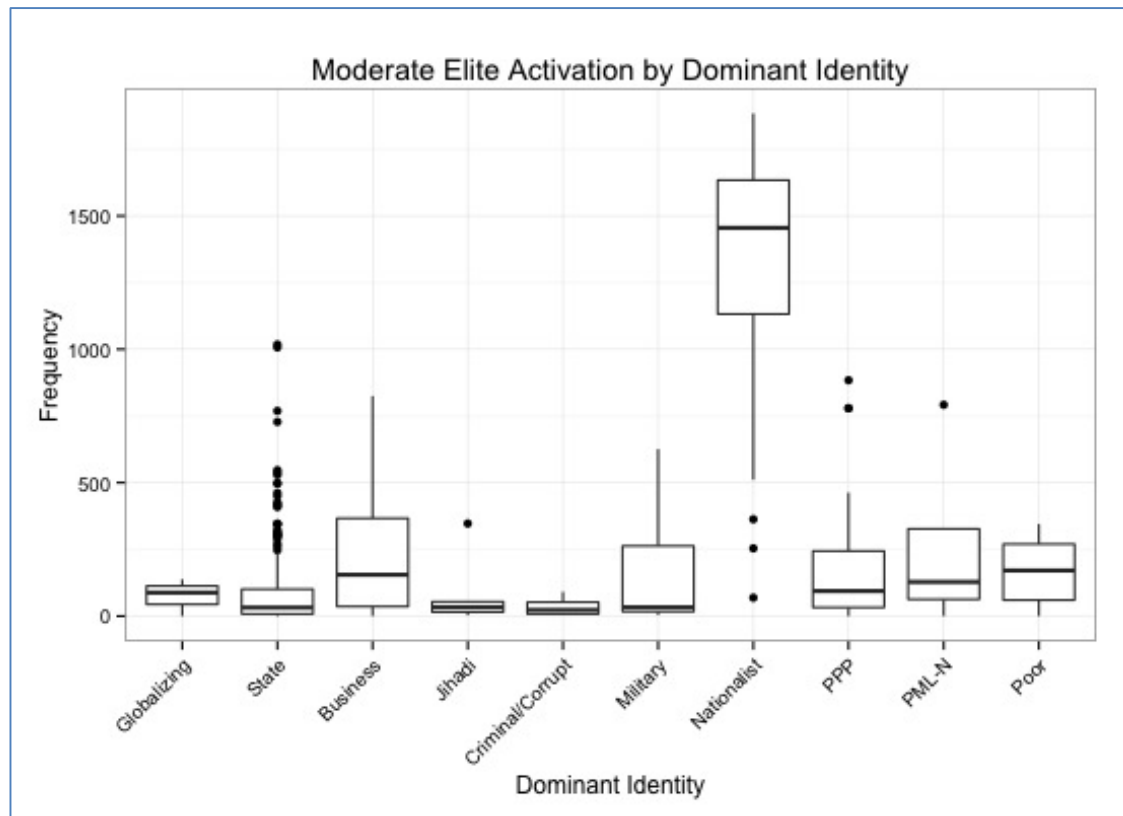


Figure 14 Box and whisker plot showing how many elites are activated on Nationalist when different identities are dominant

Pakistani experts see this scenario as the most optimistic future out of the five options because it means that democracy is not only functioning, but also solving the country's problems. In such a future, a political party with strong ideological platforms geared towards improving the political, economic, social issues of the nation would win. Although there is no guarantee that Pakistan will see such a government in the near future, there are signs that this is a viable option.

Many would argue that Imran Khan's political party, Tehreek-e-Insaf, winning the election in May 2013 would represent one way that a nationalist government could come to power. For the first time, a party has a platform that addresses important welfare issues such as corruption, education, terrorism and much more. Furthermore, he is striving to build a political party institution that differs from the political dynasties established by families such as Bhutto and Sharif. Although he is a competitive candidate in the upcoming election, it is unlikely that he will gain the majority in Parliament necessary to rule the nation. In the model, this future occurs the second most frequently after the status quo. Although this does not necessarily mean that it is the second most likely future, it does suggest that it is less difficult for Pakistan to pivot towards this future rather than others.

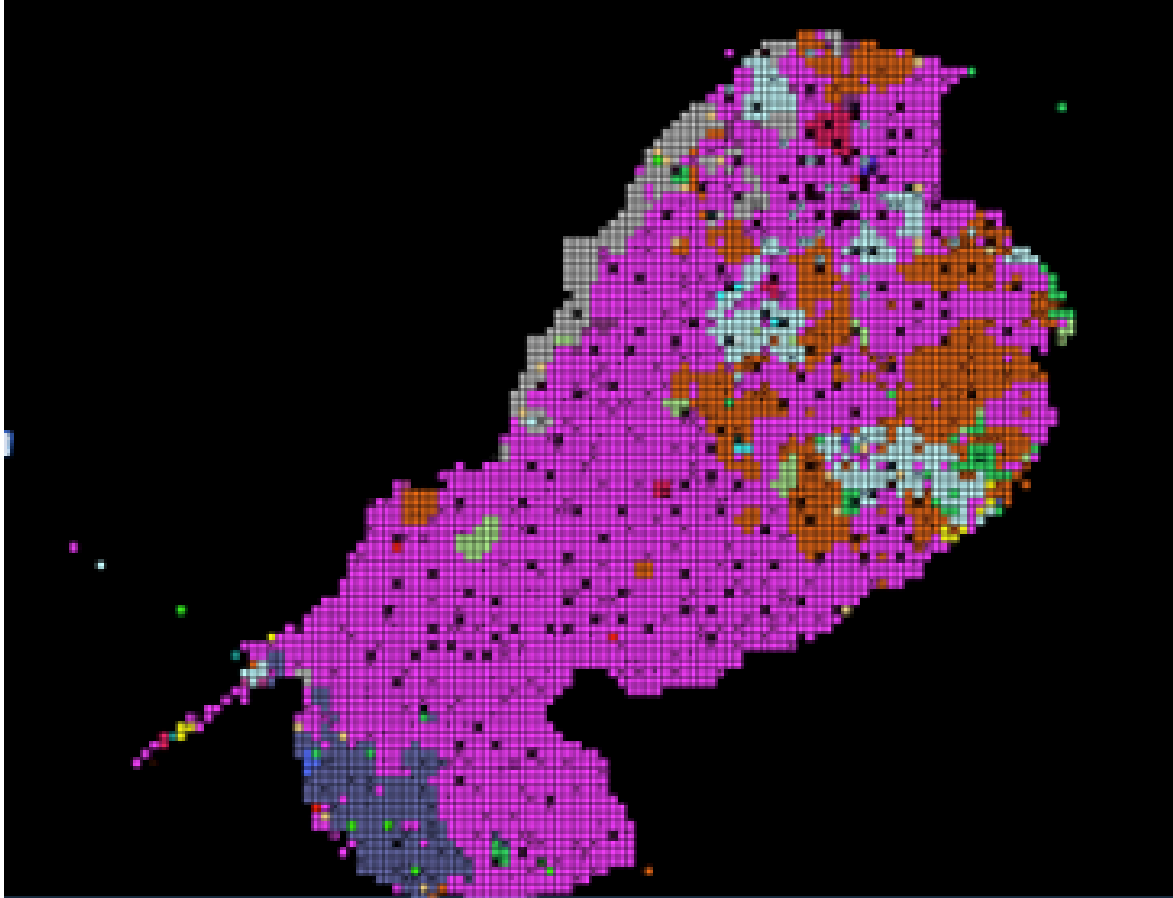


Figure 15 A future in which the nationalist identity is dominant on the way to $t=100$

Figure 15 provides an example of a moderate state. The magenta represents the nationalist identity and a significant portion of every province includes agents activated on this identity. In such a scenario, one can imagine fewer identities feeling alienated. Less alienation may result in fewer terrorist attacks and more cohesion.

6.5: Results: Collapsed State

Figure 3 suggests that provincial identities are less likely to outweigh nationalist identities. Out of the 500 futures, the provincial identity Punjab dominates the landscape less than 30 times. Figure 4 shows the frequency with which elites are activated on the Punjabi identity. On average, .8% of the elites were activated on the Punjabi identity at time step 100. The box and whisker plot shows that the median = .1%, 1st Quartile = 0%, 3rd Quartile = .7264%.

In one future, 33.75% of the elites were activated on the Punjabi identity. The results show that the Influential E is activated on the Punjabi identity .82% of the time. Thus, this identity is less pervasive and reveals the low frequency with which this future occurs.

Figure 16 shows that when the Punjabi identity is the dominant identity, the elites are mostly activated on the Jihadi and the Poor identities. This data reveals that while the national government is collapsing and provincial identities are becoming stronger, the Jihadi influence is also increasing. In addition, the poor identity also occurs frequently. If these two identities are dominant during the same run, this could insinuate that the poor are supporting the Jihadi identity in their effort to spread an Islamic government. In the process, they are weakening the nationalist government and promoting provincial identities.

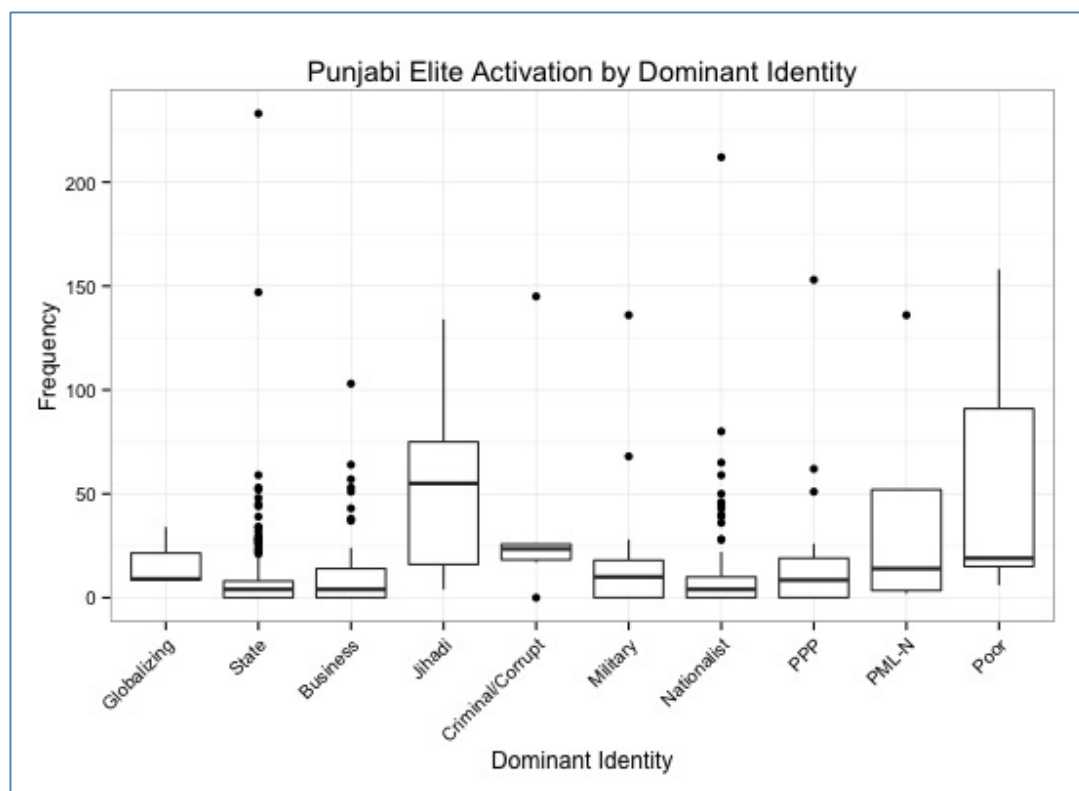


Figure 16: Box and whisker plot showing the number of elites activated on the Punjabi identity when different identities are dominant

If the provincial identity of Punjab dominates the landscape, this signifies that ethnic behavior is driving the model as opposed to any other national or religious identity.

6.6 Other Observations and Inferences

Although the previous graphs provide answers to the questions posed about the likelihood of each future, they leave out important details about the experiments. The following three graphs illustrate how frequently people lobbied, protested, or used violence during the respective futures. Figure 17 shows the frequency with which people lobbied in each of the five futures. As explained in the Dynamic Political Hierarchy section earlier in the paper, lobbying occurs when people feel connected to the dominant group in the nation by either one or two degrees of separation. When people feel connected to the dominant group in the nation, this means that there are fewer disagreements expressed through protest and violence. The graph reveals that lobbying occurs most frequently in the moderate state and a state adrift. In a moderate state, the Pakistani nationalist identity is widespread and reduces disagreement. In a state adrift, the state identity is widespread and reduces divergent opinions. Islamist, collapsed, or military states experience less lobbying than the moderate or current state. This may be the case because the Jihadi, provincial and military identities are less widespread and as a result, are more likely to experience dissenting opinions and alienate people. Protest occurs less frequently in the moderate and current state as shown in Figure 18. On average, the military and Islamist state see the most protest, followed by the collapsed state and others. Violence, however, occurs most frequently in the state adrift and non-categorized futures, followed by moderate, collapsed state, military and Islamist rule as shown in Figure 19.

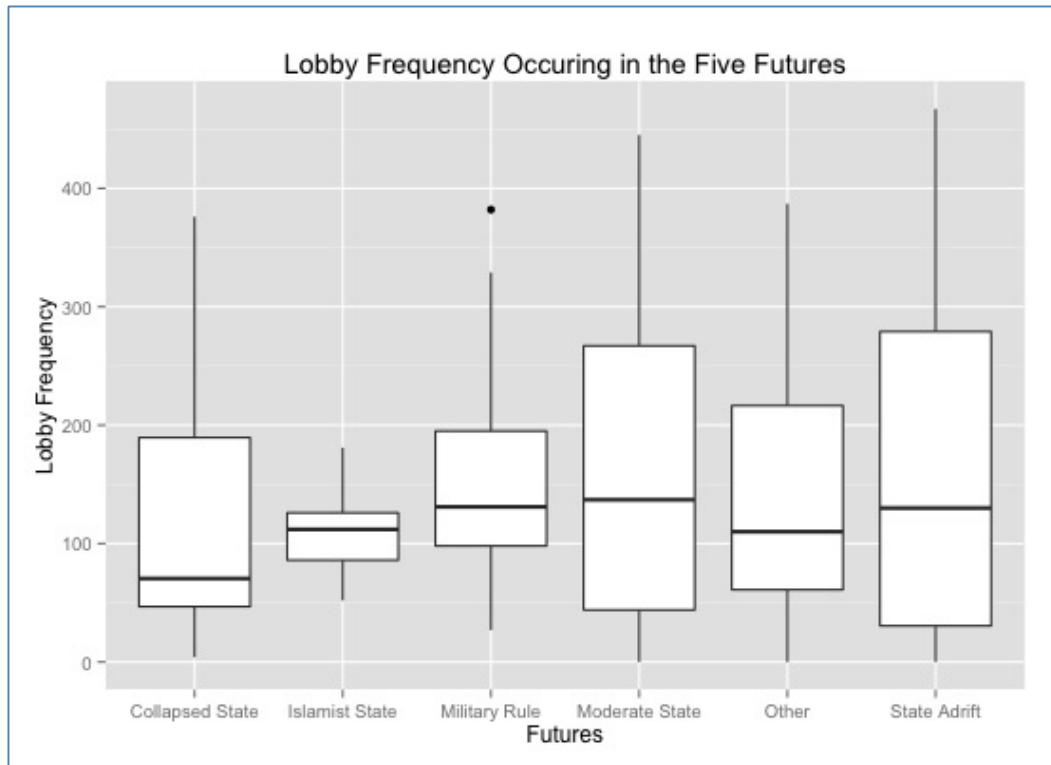


Figure 17: Box and whisker plot showing how frequently agents lobbied in each future

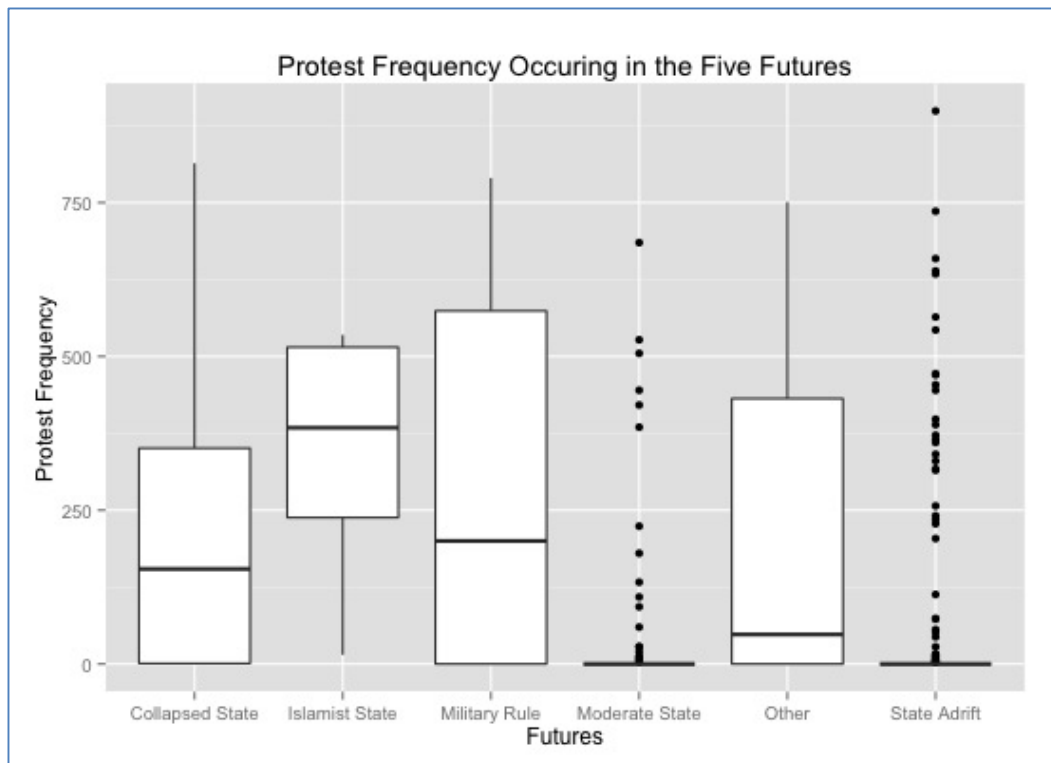


Figure 18: Box and whisker plot showing how frequently agents protested in each future

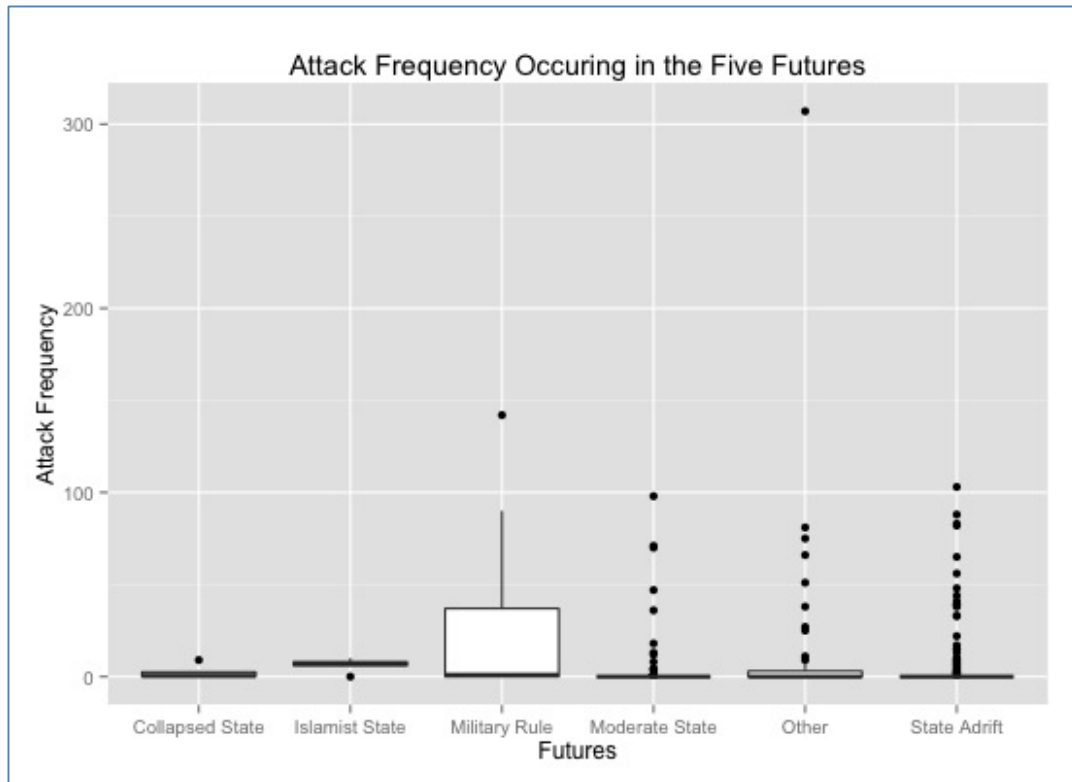


Figure 19: Box and whisker plot showing which future produced the most violence.

6.7 Summary and Discussion

Careful examination of the data reveals that certain futures, namely a state adrift and a moderate state, occur more frequently than other futures such as a military coup, an Islamist state or a collapsed state. A state adrift occurred in the majority of the scenarios. When the state identity was dominant, the most powerful agent, influential E, was frequently also activated on the state identity. There were also a few cases in which PPP was the dominant identity as well as the most powerful agent on the landscape. When the PPP identity was dominant, it was common for the majority of the elites to be activated on the PPP identity as well. The model statistics did not capture data on the elites activated on the state identity and thus it cannot be confirmed that the same pattern occurred; however, examining the new field viewer and watching the model

reveals that this is the case. Thus, a state adrift occurred more frequently than any other future. Interestingly, scholars Shuja Nawaz, Ashley Tellis and Kim Barker predicted this occurrence.

A moderate state also occurred frequently in the model as the Nationalist identity was activated second most frequently than any of the other futures. Out of the futures when the nationalist identity was dominant, there were many cases when the influential E was also activated on the nationalist identity as shown by the Mosaic graph. When the nationalist identity was dominant, it was common for the majority of the elites to be activated on the nationalist identity. Thus, a moderate state in which the leaders and elites strive for the creation of a cohesive Pakistani nationalist identity appears plausible in the model.

The remaining three futures suggested by the CFR, a military state, an Islamist state and a collapsed state occurred less frequently when measuring the identity activation, elite activation and influential E. Although these futures are still possible, they appear to require more effort than continuing on the current path of a state adrift or reacting to the current state by promoting a patriotic and nationalist identity. As stated in the results section, it appears that these identities do not achieve the same widespread popularity that the other two identities reach.

Interestingly, other futures excluded by the CFR can be seen through the model. More frequently than the military, Jihadi and provincial identities, the business identity dominates the landscape as shown in Figure 22. A business identity could insinuate that Pakistan is experiencing a growth of citizens interested in exploring the private sector and using innovation and entrepreneurship to earn money. This future appears completely plausible as currently Pakistan is making efforts to expand microfinance and encourage a segment of the population interested in starting and maintaining a business.

Another future that occurred frequently in the virtual model is one in which poverty becomes the dominant identity in the nation. A nation in which poverty is the dominant identity would consist of social unrest and political instability, as people would be using their socioeconomic identity to make political decisions. A future in which poverty remains the dominant identity could be a future in which political revolution leads people to overturn the current regime and demand equality.

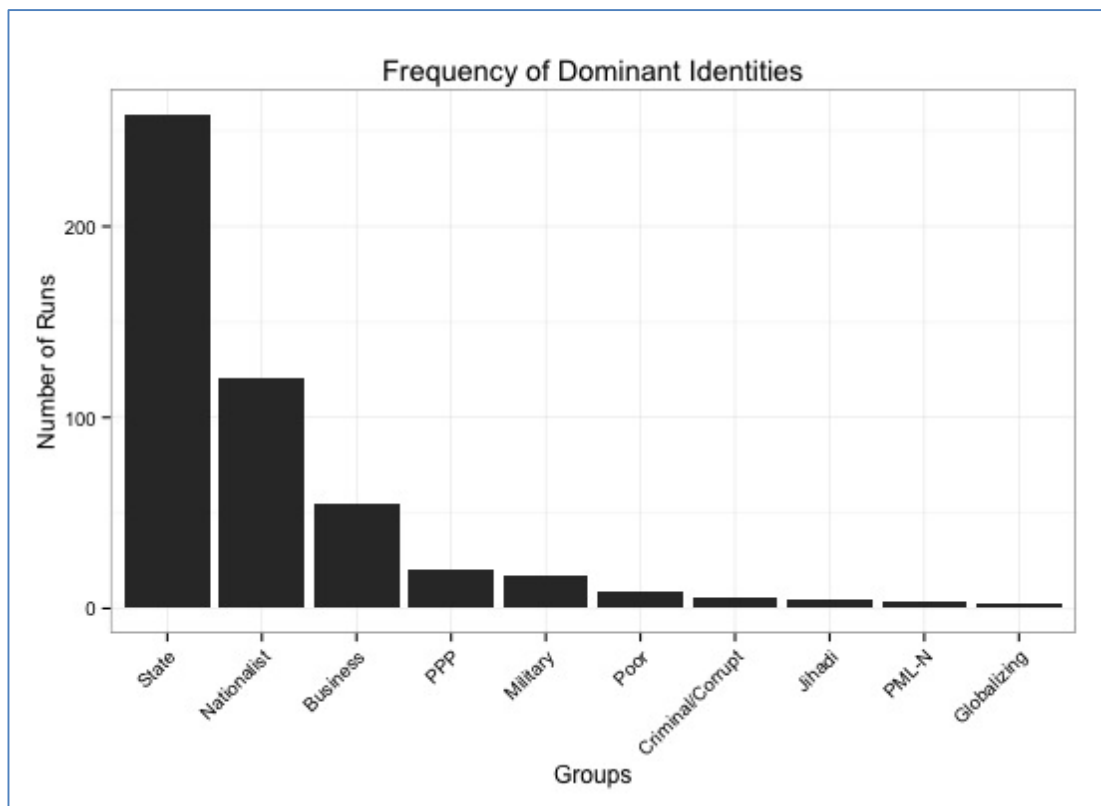


Figure 22: Bar graph displaying how frequently different identities are dominant

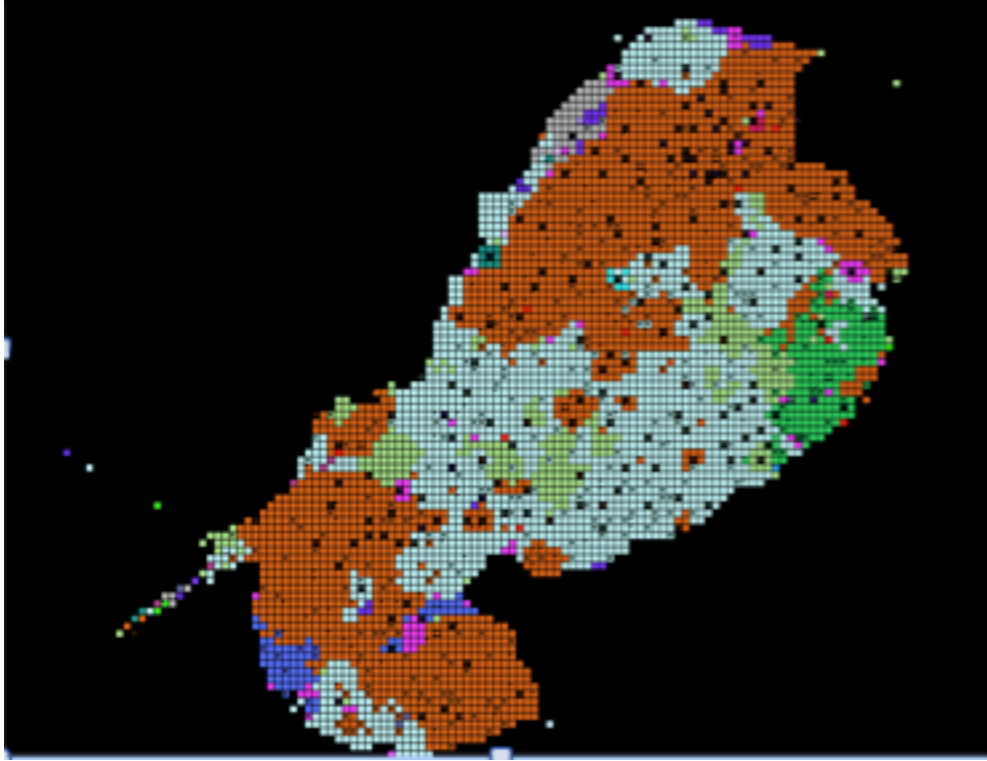


Figure 23: Screenshot in which the Poor Identity dominates the landscape at $t=100$. Poor identity represented through the light blue shading

Furthermore, the model produced interesting futures in which combinations of identities took over the nation. Figure 24 shows an example of a future that did not fit neatly into the five categories produced by the CFR report. The dark blue represents the PPP identity and the pink represents the business identity. In this case, the PPP and the business communities have taken over the country. This could represent a future in which the PPP has promoted business or supported endeavors that would help grow the country's economy.

Figure 24 represents another example of a future that did not fit neatly into the five categories produced by the CFR report. The yellow identity represents the military and the light green represents the PML-Q identity. Since the PML-Q political party was General Musharraf's political party, it seems likely that the military would also have tremendous support.

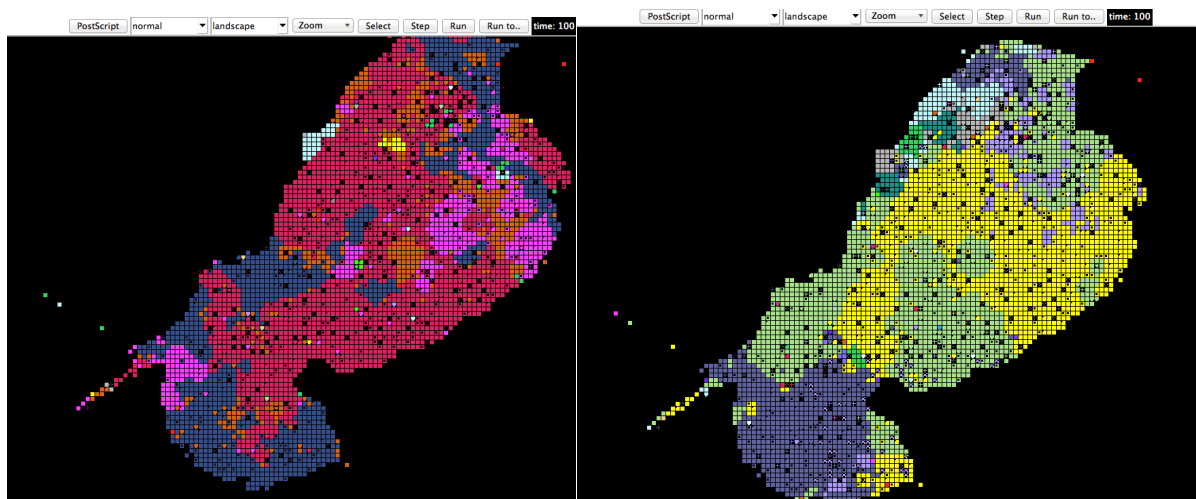


Figure 24: On the left, a snapshot of a future of Virtual Pakistan at time step 100 in which the business identity and PPP identity dominate the landscape. On the right, a snapshot of a future of Virtual Pakistan at time step 100 in which the military and the PML-Q identity dominate the landscape.

7. Conclusion

Policymakers are constantly striving to answer the question - what will happen next?

Until recently, they could only rely on area experts to provide answers to that question. Agent-based models, however, have the capability to change the way policymakers review scenarios.

Pakistan, as discussed earlier, is one of the most important country's to understand. With suicide bombings, religious and separatist movements, poor economic conditions and weak political institutions, Pakistan is experiencing one of the toughest times in its history. On top of this already stressful situation, Pakistan maintains nuclear capabilities and is also an ally of the United States, assisting in the War in Afghanistan since 2001. All of these ingredients suggest that there is a great demand to understand the nation and examine which direction the nation will take.

The Council on Foreign Relations, and other Pakistan experts, answer this question by closely examining five possible futures that Pakistan could take based on qualitative analysis. In this thesis, I attempt to approach the same question – what will happen to Pakistan – through a

non-conventional technique of agent-based modeling. I hypothesize that agent-based modeling will reveal more information and will complement the CFR's report. To accomplish this task, I explained the model building process step-by-step, run the experiment and analyze the results gathered from the test. Comparing the Council on Foreign Relations' paper to the results from the model, I examined to what extent the model facilitates the five futures presented by the CFR. More specifically, I seek to answer – How does the model help policymakers and people who are trying to understand Pakistan? And what does the model reveal that the literature excludes?

Agent based models do not attempt to forecast which future will happen, but instead provide a more useful way of exploring the space of possible futures of a nation like Pakistan. Through the model building process, it was obvious that agent-based models require a complete dissection and analysis of every aspect of society. When listening to experts discuss their thoughts on Pakistan's future or reading literature on the subject, authors and scholars rarely go into detail regarding how they are defining a "military elite" or a "Punjabi." The CFR report acknowledges that elites have influence over the population, but the scholars do not systematically account for how much influence elites have, whom they interact with, and how elites' interactions impact the futures as a whole. Agent-based modelers need to answer such questions, as the computer simulation does not work unless everything is defined as explicitly as possible.

Qualitative experts studying Pakistan have no requirement to specify their terms and sometimes leave terms undefined. They also do not need to explain which theories they are basing their predictions on. Although theory is not always necessary, it ensures that a scholar is looking at a work consistently and not accidentally incorporating biases into their thoughts on a situation. Agent-based modeling prevents such incidences from occurring as all of the rules

guiding model behavior are based on theory. Such consistency is unique to computer simulation and thus complements qualitative models such as the CFR report.

The agent-based model also allowed visualization of patterns in a spatial realm. As discussed in the model building section, the model accounts for the various provinces, divisions and districts. Most of the identities, ethnic, religious, socioeconomic and societal identities, are seeded at the provincial level. Creating and seeding Virtual Pakistan forces the researcher to find detailed data and systematically think about how provincial activity impacts the future of the nation.

Agent-based modeling also greatly enhanced the CFR's report by adding to the possible scenarios. There are futures that are not mentioned in the CFR report that occur frequently in the model. For example, the business identity dominates the landscape on multiple occasions signifying that Pakistan could experience more economic than political changes and could become less agriculture over the coming years. Such a scenario correlates with theories in the literature suggesting that Pakistan will experience climate changes in the coming years that may negatively impact the agriculture sector. Agent-based modeling does not predict futures as much as it serves as a palette of possible futures. While the human brain is only capable of imagining a finite number of scenarios, the computer lacks such biases or limitations and can create a wider range of trajectories.

While the model is extremely useful, it has one main limitation. As discussed earlier, agent-based models are only as good as the data entered into them. While most of the data was obtained from surveys and the census, there was some unavailable data. For example, there is little to no available information on the religious and ethnic breakdown of Pakistan's business

elites; thus, this information was assumed based on reading books and articles. As more information becomes available, it can easily be entered to improve the model.

There are many benefits and limitations to using agent-based modeling to measure the CFR's report on Pakistan's five futures. The most important added value of agent-based modeling is that it provides a palette of futures broader than those discussed by the CFR and others. Each future provides a unique story of what Pakistan's future could look like and in this case, 500 unique stories were created.

After such a long analysis of Pakistan, the question remains – what do the scholars and the model suggest will happen to Pakistan in the coming years? The qualitative and quantitative models suggest that Pakistan will continue to muddle through without any nation building efforts or political, economic or social improvements. Such a scenario means that Pakistan will most likely continue on its current path without improvements. In the weeks following the experimentation, on March 16, 2013, Pakistan completed its first term of civilian governance since its founding in 1947. A caretaker government currently governs the nation and will remain in charge until the next election in May 2013. One could assume that if PPP leaders, in charge from 2008 to 2013, get reelected, the country will continue on its path of muddling through.

However, maintaining the status quo seems unsustainable as Pakistan is facing many unique problems that it has never faced in its history. In the coming years, American troops will completely withdraw from Afghanistan. As discussed earlier, Pakistan is an ally of the United States and when the United States withdraws, it will need to find a way to deal with the instability that will follow, as there is a high probability that all of the terrorist organizations attacking American troops will increase attacks in Pakistan. To make matters worse, Pakistan is facing one of the worst energy crises in its history. Major cities, for example, do not have

electricity for up to 12 hours a day,⁷² roughly 40-55 million people do not have access to clean drinking water⁷³ and much more. These crises are preventing people from investing in Pakistan's economy. Although these are often seen as secondary issues after terrorism and Islamic extremism, scholars argue that this may be one of the biggest problems in Pakistan's future. These social and economic issues could worsen and lead to a drastic future if Pakistan continues on its current path of "muddling through." Continuing with the status quo, therefore, may actually push Pakistan towards one of the other futures outlined by the CFR and the model.

Pakistan is currently experiencing a plethora of problems including, but not limited to, poverty, over-population, water shortages, climate instability, political instability, violence from internal sectarian terrorism, violence from separatist movements, violence by American drone attacks, economic instability, corruption, poor public education, energy crisis, threat of a military coup, health care, job security, food security, and no nation building efforts. All of these problems can be solved over time if scholars, policymakers and other stakeholders work in earnest to find solutions. I built the model to facilitate the understanding of the current problems facing Pakistan, and possibly opening a door for resolving them.

⁷² Staff Reporter. (2012, November 18). Be ready for more loadshedding load! *The Nation*.
<http://www.nation.com.pk/pakistan-news-newspaper-daily-english-online/lahore/18-Nov-2012/be-ready-for-more-loadshedding-load>

⁷³ Ali, S. (2013, January 31). Pakistan's water woes: A ticking time bomb. *Dawn*.
<http://dawn.com/2013/01/31/pakistans-water-woes-a-ticking-time-bomb/>

References

- Al Jazeera and Agencies. (2013, March 17). Pakistan government completes full term. *Al Jazeera*. http://www.aljazeera.com/video/asia/2013/03/2013316193951188553.html?utm_content=automate&utm_campaign=Trial6&utm_source=NewSocialFlow&utm_term=plustweets&utm_medium=MasterAccount
- Ali, S. (2013, January 31). Pakistan's water woes: A ticking time bomb. *Dawn*. <http://dawn.com/2013/01/31/pakistans-water-woes-a-ticking-time-bomb/>
- Axtell, Robert. (2000) "Why Agents? On the Varied Motivations for Agents Computing in the Social Sciences". *Center on Social and Economic Dynamics – Working Paper*: 1-22. <http://www.brookings.edu/~media/research/files/reports/2000/11/technology%20axtell/agents>.
- Bajpai, Kanti. (2011). Pakistan's Future: Muddle Along. In S. Cohen (Author), *The Future of Pakistan* (pp. 199-214). Washington, DC: Brookings Institute.
- Berger, Thomas. "Agent-Based Spatial Models Applied to Agriculture: a Simulation Tool for Technology Diffusion, Resource Use Changes and Policy Analysis." *Agricultural Economics* 25 (2001): 245-60.
- Birsel, R. (2008, September 6). Zardari wins Pakistan election. *Reuters*. <http://www.reuters.com/article/2008/09/06/us-pakistan-election-dUSSP17223420080906>
- Cohen, S. P. (2011). *The Future of Pakistan*. Washington, DC: Brookings Institution.
- Epstein, Joshua. (1995) "Agent-Based Computer Models and Generative Social Science." *John Wiley & Sons, Inc.* 4 41-60. Pg. 2
- Estimating the Middle Class in Pakistan. (2011). *Pakistan Institute of Development Economic*, 77, 1-20.

hazaras-in-balochistan/

- Fair, C., Ramsay, C., & Kull, S. (2007). Pakistani Public Opinion on Democracy, Islamist Militancy, and Relations with the U.S. *United States Institute of Peace Working Paper*, 1-44.
- Gusterson, H. (2001). The Virtual Nuclear Weapons Laboratory. *Wiley-Blackwell*, 28(2), 417-437
- Johnson, Paul. (1998): *Rational Actors versus Adaptive Agents: Social Science Implications*. American Political Science Association 1-22.
- Khan, I. (2006). Contending Identities of Pakistan and The Issue of Democratic Governance. *Peace and Democracy in South Asia*, 2(1 and 2), 50-70.
- Khan, S. B. (2007, September 14). Punjab's dominance in army being reduced: ISPR. *Dawn*.
- Laver, M., & Sergenti, E. (2012). *Party Competition: An Agent-based Model*. Princeton, NJ: Princeton University Press.
- Lieven, A. (2011). *Pakistan: A Hard Country*. New York, NY: PublicAffairs.
- Lustick, I., Alcorn, B., Garces, M., & Ruvinsky, A. (2010). From Theory to Simulation: The Dynamic Political Hierarchy in Country Virtualization Models. *Annual Meeting of the American Political Science Association*. Retrieved from
- Lustick, I., & Miodownik, D. (2009). Abstractions, Ensembles, and Virtualizations: Simplicity and Complexity in Agent-Based Modeling. *Comparative Politics*, 41, 223-244.
- Lustick, I. (2011). [Review of the book *Party Competition: An Agent-Based Model*].

Perspectives on Politics, 1026-1028.

<https://www.sas.upenn.edu/polisci/sites/www.sas.upenn.edu.polisci/files/Review%20of%20Laver%20and%20Sergenti.pdf>

Lustick, I. (2000). Agent-based Modeling of Collective Identity: Testing Constructivist Theory.

Journal of Artificial Societies and Social Simulation, 3(1).

<http://jasss.soc.surrey.ac.uk/3/1/1.html>

McNamara, Laura Agnes. (2001). "Ways of Knowing about Weapons: The Cold War's

End at the Los Alamos National Laboratory." Diss. University of New Mexico,

http://www.fas.org/programs/ssp/nukes/new_nuclear_weapons/cwendlosalamos.pdf

Miller, John H. (2007) *Complex Adaptive Systems: An Introduction to Computational*

Models of Social Life. Princeton: Princeton UP.

<http://vserver1.cscs.lsa.umich.edu/~rlr/CSCS530/uploads/Main/Berger-ABM-Innovation-Diffusion-Agriculture.pdf>.

Moran, M. (2011). Crisis Guide: Pakistan. Retrieved from

http://www.cfr.org/interactives/CG_Pakistan/index.html?cid=otc-marketinguse-pakistan_cg

Out of Sight, Out of Mind: a Visualization of Drone Strikes in Pakistan since 2004. (2013).

Retrieved March 21, 2013, from <http://drones.pitchinteractive.com>

Pakistan poll: President Zardari party 'makes gains'. (2012, March 2). *BBC*, Asia.

Retrieved from <http://www.bbc.co.uk/news/world-asia-17225502>

PAKISTAN - CENSUS [Data]. Retrieved December 2, 2011, from Government of

Pakistan website: <http://www.census.gov.pk/index.php>

PAKISTAN - CENSUS [Data]. Retrieved December 2, 2011, from Government of

- Pakistan website: <http://www.census.gov.pk/index.php>
- Perlez, J. (2008, March 11). From Prison to Zenith of Politics in Pakistan. *New York Times*.
- Profile: Asif Ali Zardari. (2011, December 7). *BBC*, Asia. Retrieved from <http://www.bbc.co.uk/news/world-asia-16066406>
- Qadri, M. (2012, April 19). Pakistan is in denial over spreading sectarian violence. <http://www.guardian.co.uk/commentisfree/2012/apr/19/pakistan-sectarian-violence>
- Qadir, S. (2011). Still an Uncertain Future. In S. Cohen (Author), *The Future of Pakistan* (pp. 199-214). Washington, DC: Brookings Institute.
- Rashid, A. (2012). *Pakistan on the Brink: The Future of America, Pakistan, and Afghanistan*. New York, NY: Penguin Group.
- Riedel, B. (2011). *Deadly Embrace: Pakistan, America, and the Future of the Global Jihad*. Washington, DC: Brookings Institution
- Riedel, B. (2013, January 4). Battle for the Soul of Pakistan. *India Today*.
<http://www.brookings.edu/research/opinions/2013/01/04-pakistan-riedel>
- Riedel, B. (2012, December 29). Pakistan's Impossible Year: Elections, Army Intrigue, and More. *The Daily Beast*.
<http://www.brookings.edu/research/opinions/2012/12/29-pakistan-riedel>
- Shafqat, S. (2011). Praetorians and the People. In M. Lodhi (Author), *Pakistan: Beyond the 'Crisis State'* (pp. 95-112). New York, NY: Columbia University Press
- Shah, A. (2011). Security, Soldiers, and the State. In S. Cohen (Author), *The Future of Pakistan* (pp. 199-214). Washington, DC: Brookings Institute.
- Siddiqi, A. (2013, January 14). Analysis: Violence against Hazaras in Balochistan. *The*

Express Tribune. <http://tribune.com.pk/story/493645/analysis-violence-against->

Staff Reporter. (2012, November 18). Be ready for more loadshedding load! *The Nation*.

<http://www.nation.com.pk/pakistan-news-newspaper-daily-english-online/lahore/18-Nov-2012/be-ready-for-more-loadshedding-load>

Waraich, O. (2013, March 29). The Return of the General: Why is Musharraf Running

for Office in Pakistan? *Time*. <http://world.time.com/2013/03/29/>

the-return-of-the-general-why-is-musharraf-running-for-office-in-pakistan/#ixzz2P0LzWWDv

http://www.nytimes.com/2008/03/11/world/asia/11pstan.html?pagewanted=1&_r=2

Appendix A**DPH Routines from the GPM**

Routine parameter	Literal translation	Implications
routine 'default_become_protest_condition' composite code " (angry and ([DPH_sub]==2) and (rand < Mobilization_Factor(activated_identity))) or (((DPH_act]==1) and ([DPH_sub]==2) and (rand < Group_Mobilization_Factor(activated_id entity))) or (((DPH_act]==0) and ([DPH_sub]==2) and (rand < ((Group_Mobilization_Factor(activated_i dentity)+AntiSystem_Bonus(activated_id entity))))))" end	If 'angry' and 'DPH_sub' is 2 (regime) and rand < 'Mobilization_factor;' or, if 'DPH_act' is 1 (system) and DPH_sub' is 2 (regime) and rand < 'Group_Mobilization_Factor;' or if 'DPH_act' is 0 (non- system) and 'DPH_sub' is 2 (regime) and rand < 'Group_Mobilization_Factor' plus 'AntiSystem_Bonus;' then 'default_become_protest' condition occurs	If any one of three sets of conditions are true: 1) The agent is angry, it is a regime-level agent, and a random selection is less than the mobilization factor 2) The agent is activated on a system- level identity, it is a regime-level agent, and a random selection is less than the group mobilization factor 3) The agent is activated on a non- system identity, it is a regime-level agent, and a random selection is less than the sum of the group mobilization factor and the anti-system bonus Then the agent is eligible for protest.
routine 'default_become_lobby_condition' composite code "(angry and ([DPH_sub]>2) and ((rand < Mobilization_Factor(activated_identity))) or (([DPH_act]==1) and ([DPH_sub]>2) and (rand < Group_Mobilization_Factor(activated_id entity))) or (([DPH_act]==0) and ([DPH_sub]>2) and (rand < ((Group_Mobilization_Factor(activated_i dentity)+AntiSystem_Bonus(activated_id entity))))))" end	If 'angry' and 'DPH_sub' is greater than 2 (regime) and rand < 'Mobilization_factor;' or, if 'DPH_act' is 1 (system) and DPH_sub' is greater than 2 (regime) and rand < 'Group_Mobilization_Factor;' or if 'DPH_act' is 0 (non- system) and 'DPH_sub' is greater than 2 (regime) and rand < 'Group_Mobilization_Factor' plus 'AntiSystem_Bonus;' then 'default_become_lobby' condition occurs	If any one of three sets of conditions are true: 1) The agent is angry, it is an incumbent or dominant level agent, and a random selection is less than the mobilization factor 2) The agent is activated on a system- level identity, it is an incumbent or dominant-level agent, and a random selection is less than the group mobilization factor 3) The agent is activated on a non- system identity, it is an incumbent or dominant level agent, and a random selection is less than the sum of the group mobilization factor and the anti-system bonus Then the agent is eligible to lobby.
remain_activated_condition	rand < 3333	-Refers to 'remain_activated_condition' keeps the identity the same when an agent becomes a protest agent -the rule allows 1/3 of the agents to become

		protest agents
activate_on_highest_condition	(rand > 3333) and (rand < 6666)	-activates the agent on the highest bias identity in the repertoire ; this happens to a 1/3 of the agents who become protest agents
randomize_activation_condition	rand > 6666	-activates the agent on a random identity in their repertoire; this happens to the final third of the agents who become protest agents.

DPH Rules extracted from the GPM

Rule	Translation in PS-I
rule 'system_attack' becomes 'system_attack' condition "[effect_code_marker]" attribute 'angry' "angry" attribute 'prev_act' "activated([cache])" attribute 'effect_code_marker' "0" end	-if the agent's effect code marker is true, then the agent angry value is part of your attributes, saves your previously activated identity and their effect code marker becomes 0.
rule 'system_attack' becomes 'basic' condition "true" attribute 'angry' "angry" attribute 'prev_act' "activated([cache])"end	-If the agent is activated on system attack, then the agent acquires the angry attribute and they activate on their previously activated identity -if your effect code marker is 0.
rule 'system_victim' becomes 'system_victim' condition "[effect_code_marker]" attribute 'angry' "angry" attribute 'effect_code_marker' "0" end	If agent's effect code marker indicates that the agent is a system victim agent, then the agent becomes angry and their effect code marker becomes 0.
rule 'system_victim' becomes 'basic' condition "true" attribute 'angry' "angry" attribute 'prev_act' "activated([cache])" attribute 'Influence_level' "[Influence_level]-29" end	If the agent is a system victim agent, then the agent becomes angry, activates on their previously activated identity and their influence level reduces by 29.
rule 'protest' becomes 'basic' condition "true" attribute 'Influence_level' "[Influence_level]-protest_influence" attribute 'angry' "angry" attribute 'prev_act' "activated([cache])" end	If an agent is activated on protest, then their influence level decreases by the protest_influence value, the agent becomes angry and is activated on their previously activated identity.
rule 'lobby' becomes 'basic' condition "true"	If an agent is activated on lobby, then they acquire the angry attribute and activate on their previously activated

<pre> attribute 'angry' "angry" attribute 'prev_act' "activated([cache])" end </pre>	identity.
<pre> rule 'basic' becomes 'lobby' condition "default_become_lobby_condition and mobilized==0 and activate_on_highest_condition" attribute 'cache' "repertoire(max_bias(subscription_set([cache]),1),[cache])" attribute 'angry' "angry" attribute 'prev_act' "activated([cache]) end </pre>	If an agent meets the ‘default_become_lobby condition’ (explicitly stating the rule than an agent may be activated on a non-system or system level identity but if it has an incumbent or a dominant level identity in it’s repertoire), then it is going to lobby; is mobilized on 0; and is activated on their highest condition, then they activate on the identity with the maximum bias in their repertoire, acquire the angry attribute and activate on their previously activated identity.
<pre> Rule 'basic' becomes 'lobby' condition "default_become_lobby_condition and mobilized==0 and randomize_activation_condition" attribute 'cache' "repertoire(random_element_hash(subscription_set ([cache]),hash(agent_x,agent_y,time,evolution_see d)),[cache])" attribute 'angry' "angry" attribute 'prev_act' "activated([cache])" end </pre>	If an agent meets the ‘default_become_lobby’ condition and is mobilized on 0, then they activate on a random identity in their repertoire, acquire the angry attribute, and activate ontheir previously activated identity.
<pre> rule 'basic' becomes 'lobby' condition "default_become_lobby_condition and mobilized==0 and remain_activated_condition" attribute 'angry' "angry" attribute 'prev_act' "activated([cache])" end </pre>	If an agent meets the default become lobby condition, is not mobilized, then they remain activated on their current identity to lobby, acquire the angry attribute, and activate on their previously activated identity.

rule 'basic' becomes 'basic' condition "(cis(16) == 0) and oppressed_region and (military_presence>3)" attribute 'oppressed' "true" attribute 'angry' "angry" attribute 'prev_act' "activated([cache])" end	If an agent is not subscribed on the military identity and surrounded by more than three military identities in the oppressed region, then they become oppressed, angry and activated on their previously activated identity.
rule 'basic' becomes 'basic' condition "cis(16) or (military_presence<3)" attribute 'oppressed' "false" attribute 'angry' "angry" attribute 'prev_act' "activated([cache])" end	If the agent is activated on the military identity or is surrounded by three or less military identities, then they are not oppressed, acquire the angry attribute and are their previously activated identity is saved.
rule 'basic' becomes 'basic' condition "true" attribute 'prev_act' "activated([cache])" attribute 'angry' "angry" end	If the agent is basic, then they activate on their previously activated identity and acquire the angry attribute.
rule 'basic' becomes 'protest' condition "default_become_protest_condition and mobilized==0 and activate_on_highest_condition" attribute 'cache' "repertoire(max_bias(subscription_set([cache]),1),[cache])" attribute 'Influence_level'	If the 'default_become_protest,' 'activate_on_highest' and 'mobilized=0' conditions are satisfied, then the identity with the highest bias is selected, and the influence level of that agent increases from its current level as the 'protest_influence' value is added to agent influence's influence level, and the 'anger' attribute is gained.

<pre> "[Influence_level]+protest_influence" attribute 'angry' "angry" attribute 'prev_act' "activated([cache])" end </pre>	
<pre> rule 'basic' becomes 'protest' condition "default_become_protest_condition and mobilized==0 and remain_activated_condition" attribute 'Influence_level' "[Influence_level]+protest_influence" attribute 'angry' "angry" attribute 'prev_act' "activated([cache])" end </pre>	If the 'default_become_protest,' 'activate_on_highest' and 'mobilized=0' conditions are satisfied, then the agent protests activated on its current identity, and the influence level of that agent increases from its current level as the 'protest_influence' value is added to agent influence's influence level, and the 'anger' attribute is gained.
<pre> rule 'basic' becomes 'protest' condition "default_become_protest_condition and mobilized==0 and randomize_activation_condition" attribute 'cache' "repertoire(random_element_hash(subscri ption_set([cache]),hash(agent_x,agent_y,time,evol ution_seed)),[cache])" attribute 'Influence_level' "[Influence_level]+protest_influence" attribute 'angry' "angry" attribute 'prev_act' "activated([cache])" </pre>	If the 'default_become_protest,' 'activate_on_highest' and 'mobilized=0' conditions are satisfied, then the agent protests activated on a random identity in its repertoire and, and the influence level of that agent increases from its current level as the 'protest_influence' value is added to agent influence's influence level, and the 'anger' attribute is gained

end	
-----	--

Appendix B

Experimentation Record and Log Notes

Objective: To operationalize the five futures of Pakistan presented by the Council on Foreign Relations.

***Theory 1:** Operationalizing regime change through observing the identity activation of the influential E agent. This is one possible way of representing a regime change because the influential E agent represents the most influential, far-reaching and powerful agent in the landscape. If the activated identity of the influential E changes, then that means the most powerful agent in the landscape has changed its affiliation and is leading with a different mindset. The underlying assumption behind this strategy is that the influential E operates differently from other agents. Rather than having one activated identity and multiple subscribed identities, influential E is a public figure of some sort, and thus its private life is politically inseparable from its private life. None of the other influential agents operate this way because even though they might be public figures, they could also be private bureaucrats or lower military ranks. In other words, there is no way to determine whether the remaining influential A, B, C or D agents are public figures or private figures and thus we can only treat influential E differently from the others. This means that the repertoire of influential E should contain only the identities that represent the identity most associated with the five futures.*

Date	Experiment	Experiment's purpose	Problems and modifications
10/12/12	Today I added the "influential_seeding-pakistan.scp" folder so that the new virtualization model includes influentials A, B, C, D and E. Then I added a line in the GPM that allows me to track the Identity activation of influential E. I am now running the baseline 100 times for 60 time steps each and tracking the Identity activation of influential E.	Tracking the activation of influential E is important because the activation of influential E determines which type of government Pakistan is experiencing. If the influential E is activated on military, there is a coup occurring. If influential E is activated on the nationalist identit, it is a moderate state. If the influential E is on the PPP, then it is a state adrift; The other two futures - Jihadi =Islamic and provincial =Punjabi	PROBLEM: This model does not have properly seeded elite networks/influential agents. Therefore, the influential E agent ONLY has the Urdu identity in it's repertoire. SOLUTION: Seed all of the influential agents: A,B,C, D and E based on assumptions in books about Pakistan
10/19/12	Today I Manually changed the repertoire of identity E to reflect	-The five identities within influential E represent the	PROBLEMS: 1)The listening rules are

	the experiment listed above. The repertoire of identity E should now only include the PPP identity (A State adrift) , the military identity (Authoritarian) , the Jihadi identity (Extremist) , the Sunni Muslim Identity (Moderate government) and the Punjabi identity(secessionist); -QUESTION: Should I allow the Influential E to subscribe to and activate on other identities of not? Decision: set the cache as only these five identities and do not make the other identities unobtainable; in other words, if there are other identities that influential E wants to acquire, it can do this. -Once these changes were made, I ran the model for ten trials at 60 time steps each to examine how frequently influential E's activation would change. In this experiment, I am answering the question – does the rotation trigger for influential E need to be higher? I also wanted to track the activation of other influentials to avoid putting too much emphasis on influential E.	five futures of Pakistan. -Tracking the activation of the influential E is important this week because the activation of influential E determines which type of government Pakistan is experiencing. If the influential E is activated on military, then a military coup is occurring.	currently static, such that the identity activation of influential E has no impact on who the agent listens to more. This is a problem because if the influential E is activated on the military identity or the Punjabi identity, it maintains the same listening rules and elite networks.
10/26/12	Today I Added a Punjabi identity (Secession) to the Influential E, ran the experiment forward for 60 time steps with 50 runs to determine whether this is an effective way to measure the		PROBLEMS: Activation of Punjabi identity does not necessarily represent secession. Need to represent secession in

	collapsed State future (hypothesis: it isn't) 2) Next step: Try to understand how those identities that do not have networks		a different way.
11/2/12	-The influential E now has the capability to change! But all 10 runs gave the exact same results; I fixed this issue by adding a <code>randomize_activation</code> command Next time: Find other interesting ways besides the influential E to operationalize the five futures	1. Added <code>randomize_activation</code> so that the different runs would produce different futures; this serves as a type of burn-in period for the model.	1. No problems from this experiment

***Theory 2:** Operationalization of the five futures of Pakistan needs to be something that internally arises out of the model, not something that I specifically implant into the model (such as the influential E). This changes the way I've currently been thinking about the parameters in the model. My influential E and elite networks will carry less weight than it has been in previous experiments. From now on, I will run the baseline with the most updated information possible and select specific metrics, such as identity activation, DPH level and political mobilization patterns, to test the futures.*

Date	Experiment	Experiment's purpose	Problems and modifications
11/17	Run the baseline	Test out best methods of data analysis by observing five futures in the model	PROBLEM: Too many times the nationalist identity is dominant SOLUTION: VirPakv3 snapshot created with nationalist identity *.4 reduction with average of 30% per region and randomized activation of

			nationalist. -added a statistics column to measure intersection between elites and 5 identities
11/24	Run the baseline with changes to the nationalist identity 5 times and carefully examine the data and the snapshots	Test out best methods of data analysis by observing five futures in the model	PROBLEM: SAME problem-- Too many times the nationalist identity is dominant in the model. In 4 out of the 5 runs the nationalist identity was dominant in the last 10 time steps. SOLUTION: VirPakv3 snapshot created with nationalist identity *.3 reduction with average of 30% per region and randomized activation of nationalist.

Appendix C

The following table shows where I found data for those identities that were not in the 1998 Census. These are all of the non-regional, non-religious and non-electoral identities. In the first version of Virtual Pakistan, the data was based on my best guess, but in this version, I used primarily the Asia Barometer Survey and the Islamic World Survey to support the inclusion of specific identities. I am still in the process of looking for the “socioeconomic data,” such as urban workers and peasants. All experiments conducted this semester exclude these socioeconomic identities.

DATA COLLECTION

Additional_identities-Pakistan.csv

Identity	Identity Definition	Justification for Inclusion	Source:	Data
Nationalist	An individual who readily identifies with a nation alongside or instead of other ethnic or religious identities.	-Benedict Anderson: nation is an imagined community -People who support the nationalist	Survey Question on Asia Barometer: “How proud of your nationality are you?”	IN MODEL SCRIPT
State	An individual who works in the bureaucracy or supports the state apparatus (legislature, executive, bureaucracy)	-State is real, nation is an idea (Mary Loyoun, Skocpol;) -People who want to preserve their own panel; Huntington also good -Look back to the constitution and determine	Survey response to Asia Barometer question “I’m going to describe various types of political systems. Please indicate for each system whether you think it would be very good, fairly good or bad for this country?”	IN MODEL SCRIPT
Military	An individual who either supports the military or is part of the military (may have a family member in the military)	-Pakistani military has the propensity to stage coups and overthrow civilian government; clearly a key political actor	Survey response to this question – “What are your thoughts on having a military government: would you trust military rule?”	IN MODEL SCRIPT
Business	Represents individuals and groups who are involved in the private sector.	-Milton Freeman; I can make as many assumptions as I want as long as I understand the world better.	Survey response to this question: “How would you place your views on this scale? 1 means you agree completely with the statement on the left; 10 means you agree	Include people who answered 1,2 or 3 IN MODEL SCRIPT

		-Business elites influence the politics of any civilian democratic society; they fund campaigns and often support under the table deals	completely with the statement on the right; and if your views fall somewhere in between, you can choose any number in between.”	
Corruption/ Criminal	Represents people and groups who are constantly attempting to undermine the nation’s legitimacy through under the table deals	-	Do you think it’s justifiable for someone to accept a bribe (moadl)	IN MODEL SCRIPT
USA/Globa lization	Represents the people who support the expansion of the economy into foreign markets.		Is Exposure to US culture harmful for your country? Counted those who disagree (asia barometer)	No provincial data; only national data available, 10% to each province? Or 2% for each province?
Poor	Represents overall poverty in the country	Interesting to see which political party identities overlap with the poor identity and which other identities affect them.	Go to thesis folder>Datacollection>Poverty_pg24 file on page 24 shows statistics	SPDC provided statistics: NWFP - 37%; FATA – 60%; Punjab – 31%; Sindh – 25%; Balochistan -34%;
Urban Workers	Represents urban poor citizens	Different electoral behavior from poor agricultural – no landlord dictating voting patterns	CONTINUE WITHOUT THIS DATA	NOT IN CURRENT MODEL
Landowner /Feudal	Represents agriculturally wealthy people	Behave differently from urban wealthy – landlord dictating voting and other aspects of life	CONTINUE WITHOUT THIS DATA	NOT IN CURRENT MODEL
Middle Class Urban	Represents urban wealthier class	Up and coming group which has traditionally led revolutions in other cases (Goldstone maybe)	CONTINUE WITHOUT THIS DATA	NOT IN CURRENT MODEL

Business ???	Represents urban wealthiest class	Behave differently from poor wealthy.	CONTINUE WITHOUT THIS DATA	NOT IN CURRENT MODEL
-----------------	--------------------------------------	--	-------------------------------	----------------------------

Appendix D – ‘PakistanethnicregionCartogram.scp’

Script: GIS – Ethnic Region Cartogram

Explanation: Apply_effect “landscape” selects an agent in the model identified by the parenthesis. After selecting that agent of the model, the agent acquires the ethnic number specified. For example, in agent 8,87,8,87 is Baloch. The actual script continues for 200 pages and identifies the ethnic affiliation of every single agent. The GIS file streamlines the manual work that the modeler has to do.

```

apply_effect "landscape" "rectangle(8,87,8,87)" {"ethnic" "3"}
apply_effect "landscape" "rectangle(15,111,15,111)" {"ethnic" "3"}
apply_effect "landscape" "rectangle(16,92,16,92)" {"ethnic" "3"}
apply_effect "landscape" "rectangle(16,110,16,110)" {"ethnic" "3"}
apply_effect "landscape" "rectangle(17,109,17,109)" {"ethnic" "3"}
apply_effect "landscape" "rectangle(18,108,18,108)" {"ethnic" "3"}
apply_effect "landscape" "rectangle(18,109,18,109)" {"ethnic" "3"}
apply_effect "landscape" "rectangle(19,108,19,108)" {"ethnic" "3"}
apply_effect "landscape" "rectangle(20,94,20,94)" {"ethnic" "3"}

```

Appendix E – ‘PakistanmajorcitiesCartogram.scp’

Script: GIS – Settlement Points

Explanation: The Apply_effect “landscape” command selects the agent specified in the parenthesis and assigns the specified agent a settlement number. These settlement points assist the modeler in determining where influential agents should reside. The coding below is a small portion of the actual script demanded to complete this.

```

apply_effect "landscape" "rectangle(17,111,17,111)" {-1 "basic" "settlement" "52"}
apply_effect "landscape" "rectangle(22,106,22,106)" {-1 "basic" "settlement" "195"}
apply_effect "landscape" "rectangle(33,96,33,96)" {-1 "basic" "settlement" "94"}
apply_effect "landscape" "rectangle(41,82,41,82)" {-1 "basic" "settlement" "23"}
apply_effect "landscape" "rectangle(41,99,41,99)" {-1 "basic" "settlement" "80"}
apply_effect "landscape" "rectangle(43,94,43,94)" {-1 "basic" "settlement" "169"}
apply_effect "landscape" "rectangle(44,86,44,86)" {-1 "basic" "settlement" "150"}
apply_effect "landscape" "rectangle(44,91,44,91)" {-1 "basic" "settlement" "197"}

```

Appendix F – ‘PakistanwithpopulationCartogram.scp’

Script: GIS- Admin 1

Explanation: This script selects every agent and provides it with an admin 1 number. The admin 1 number tells the agent which province they belong to. Admin 1 “2” in this case tells the agent it is part of the Balochi province.

```

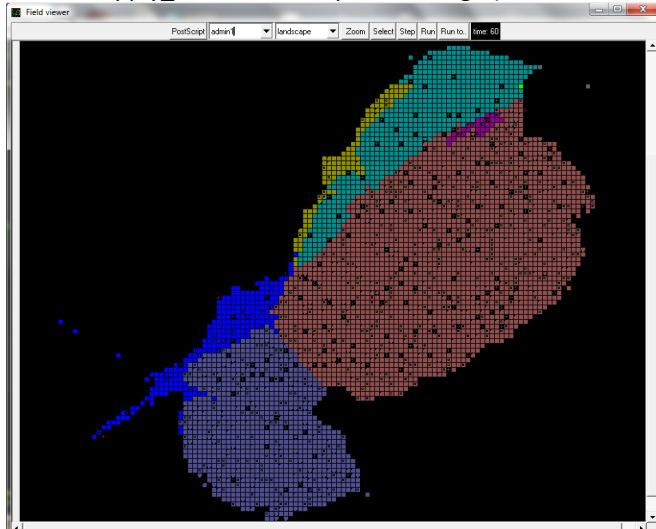
apply_effect "landscape" "rectangle(8,87,8,87)" {-1 "basic" "admin1" "2"}

```

```

apply_effect "landscape" "rectangle(11,89,11,89)" {-1 "basic" "admin1" "2"}
apply_effect "landscape" "rectangle(15,111,15,111)" {-1 "basic" "admin1" "2"}
apply_effect "landscape" "rectangle(16,110,16,110)" {-1 "basic" "admin1" "2"}
apply_effect "landscape" "rectangle(17,109,17,109)" {-1 "basic" "admin1" "2"}
apply_effect "landscape" "rectangle(18,108,18,108)" {-1 "basic" "admin1" "2"}

```



Appendix G – ‘PakistanwithpopulationCartogram2.scp’

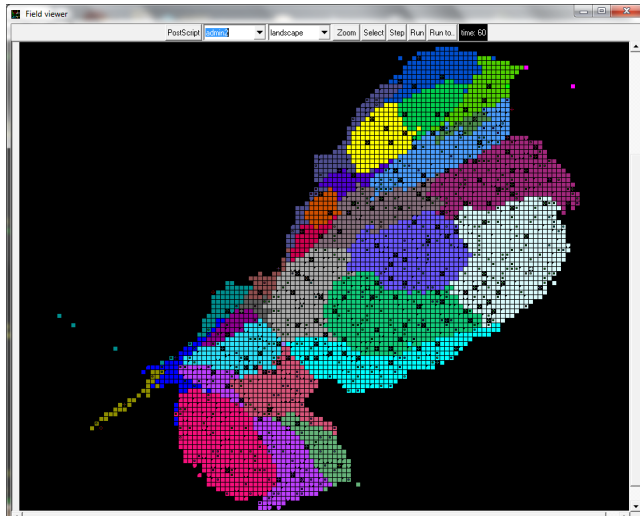
Script: GIS- Admin 2

Explanation: This script selects every agent and provides it with an admin 2 number. The admin 2 number tells the agent which division they belong to.

```

apply_effect "landscape" "rectangle(8,87,8,87)" {-1 "basic" "admin2" "5"}
apply_effect "landscape" "rectangle(11,89,11,89)" {-1 "basic" "admin2" "5"}
apply_effect "landscape" "rectangle(15,111,15,111)" {-1 "basic" "admin2" "3"}
apply_effect "landscape" "rectangle(16,110,16,110)" {-1 "basic" "admin2" "3"}
apply_effect "landscape" "rectangle(17,109,17,109)" {-1 "basic" "admin2" "3"}
apply_effect "landscape" "rectangle(18,108,18,108)" {-1 "basic" "admin2" "3"}
apply_effect "landscape" "rectangle(18,109,18,109)" {-1 "basic" "admin2" "3"}

```



Appendix H – ‘PakistanwithpopulationCartogram3.scp’

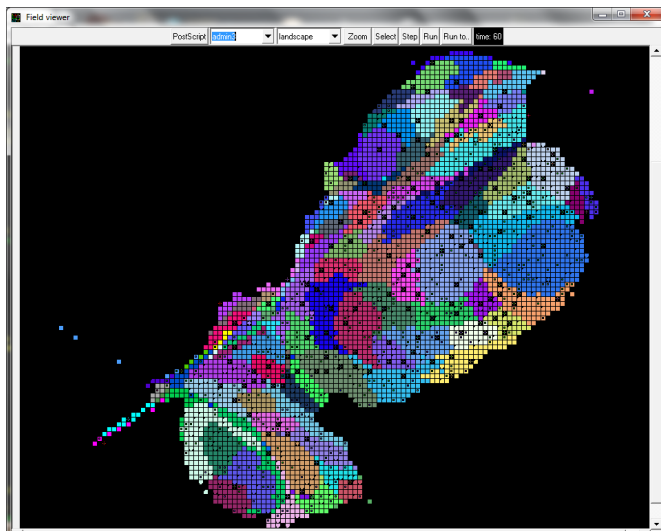
Script: GIS- Admin 3

Explanation: This script selects every agent and provides it with an admin 3 number. The admin 3 number tells the agent which district they belong to.

```

apply_effect "landscape" "rectangle(8,87,8,87)" {-1 "basic" "admin3" "24"}
apply_effect "landscape" "rectangle(11,89,11,89)" {-1 "basic" "admin3" "24"}
apply_effect "landscape" "rectangle(15,111,15,111)" {-1 "basic" "admin3" "17"}
apply_effect "landscape" "rectangle(16,110,16,110)" {-1 "basic" "admin3" "17"}
apply_effect "landscape" "rectangle(17,109,17,109)" {-1 "basic" "admin3" "18"}
apply_effect "landscape" "rectangle(18,108,18,108)" {-1 "basic" "admin3" "18"}

```



Glossary

Term	Definition in PS-I
Attribute	A characteristic of an agent that changes the nature of its interactions.
Agent	A single unit in the model that represents approximately 40,000 people and engages in micro-interactions that have macro-effects.
Agent class	A group of agents with the same nature of interactions
Agent-based modeling	A method of simulation that combines theories from game theory, evolution, complexity, sociology and more.
Identity	A fluid entity an agent associates with that can change at every time step.
Influentials:	An agent with a higher influence level than a basic agent.
Operationalization:	Translating a theory or idea from the real world into the agent-based model
Parameter:	A variable that affects the behavior of the whole model
Time step:	A created time interval used only in PS-I software
Virtualization	An agent-based model based on the information and behavior of a specific nation