Chapter 3
Politics and Power

Mark Abdollahian, Jacek Kugler, Brice Nicholson, and Hana Oh

P in PMESII stands for Political. Perhaps P was placed first merely to make the acronym easier to pronounce. However, more likely P's position of prominence was intended to signify its relative importance in international affairs.

Analysts, in particular, count redistribution of political power as one of the most notable effects of an international intervention. There is strong motivation for this; for example, a diplomatic intervention or international information campaign may shift power toward political groups which support the position favored by intervening groups; an economic or humanitarian intervention can strengthen political groups that control or, at least, take credit for aid; or a military intervention (a blockade, weapons provisioning, or invasion) can affect the military power of various political parties in a region, for better or worse.

Furthermore, the importance of politics does not end here. Political developments are frequently the very cause (vis a vis the result) of intervention. In response to economic or environmental shortfalls, for example, politics, through its decision-making processes, attempts to ameliorate competition for scarce resources and, in doing so, often produces conflict – ranging from the trivial (a local school board divided over the location of a new schoolhouse) to the catastrophic (a war between superpowers). Conflict, in turn, exerts an influence on the political and economic decisionmaking of intervention planners by creating uncertainty (e.g., regarding elections, economic trends, and overall stability) – often sufficient uncertainty to blur the boundary between profit and loss, or between victory and defeat scenarios.

Clearly, it is in the interest of intervention analysts to be able to understand and rigorously model political dynamics, but, aside from anecdotal instances, political scientists have received little support from the modeling community. However, this is beginning to change as the field blossoms. This chapter discusses recent work in this area, assesses the challenges faced, and provides a flavor of what is on the horizon. As with the rest of this book, it is hoped that this introduction stimulates further research as well as interest by intervention practitioners.

M. Abdollahian (✉)
Sentia Group, Inc, 1066 31st Street, NW, Washington D.C. 20007, USA
e-mail: maa@sentiagroup.com

A. Kott and G. Citrenbaum (eds.), *Estimating Impact*,
DOI 10.1007/978-1-4419-6235-5_3,

1 The Challenge of Political Modeling

As with many young disciplines, the world of political models is labyrinthine and balkanized; it comprises a plethora of different methodologies to analyze different aspects of similar phenomena. War, for example, is one of the primary foci of political science, as it is the most dramatic and destructive event that occurs in the political arena. As such, political scientists have long attempted to model different aspects of intra and interstate hostilities, ranging from the probability of war being initiated to the breadth, severity, and duration of a conflict, and to predicting the victor (Midlarsky 2000; Kugler and Lemke 1996; Mearsheimer 2001; Small and Singer 1982; Bueno de Mesquita and Lalman 1992; Gilpin 1981; Waltz 1979; Kahneman and Tversky 1979; Gilbert and Troitzsch 1999; Mearsheimer 2001; Bahaug and Gates 2002; Bahaug and Lujala 2004; Abdollahian and Kang 2008; Arbetman and Johnson 2008; Abdollahian et al. 2009; Levy and Thompson 2010). These inquiries result in a variety of models for different aspects of conflict and cooperation from probability through planning to reconstruction, but as yet, political scientists have no *general*, *integrated* model of when individuals, organizations, states, or collections of states will cooperate or fight.

The chief impediment to the construction of general, integrated political models is the broad theoretical question of determining which influences are most crucial in affecting political outcomes. Do individuals shape events or does history constrain individuals? This issue is known as the "levels-of-analysis problem"; i.e., whether the analyst should examine the individual decision-maker, organizational and interest group mobilization, national preferences, or the structure of the international system. Former House Speaker Tip O'Neil famously noted that "all politics are local" (O'Neill 1993); a useful (but less eloquent) corollary may be that *all politics are the aggregation of preferences and power at each level of analysis*.

Analytical questions regarding political modeling generally fall into three categories: micro-level dynamics (the expected actions and interactions of individuals, groups, or governments), intranational structural dynamics (the subnational, structural factors that politically propel a nation, such as economic prosperity, democratization, or other national indicators), and international structural dynamics (the cross-national comparisons of national factors). Each of these categories is best assessed using a particular methodology and the appropriate theoretical assumptions.

As Table 1 indicates, agent-based modeling is best applied to the near-term, micro-level dynamics of how individuals, groups, or nation-states interact. This bottom-up approach allows for detailed granularity in understanding how individuals interact in a given political environment. A vast literature (Schelling 1960; Axelrod 1986) on rational choice and microeconomic theories explains the drive behind individual-level behaviors and interactions (discussed later in this chapter). For example, how do specific insurgent groups gain support of likely sympathetic target populations: through coercion, influence, or the distribution of public goods? (Fearon and Laitin 2003).

Intra- and international dynamics have traditionally been captured at the structural level (Organski 1958; Waltz 1979; Goldstein 1988; Rasler and Thompson 1994;

Table 1 Political Methodology & Applications

Time Horison	Application Space	Methods	Available Tools
Near Team	Micro Level	Agent Based Models	Senturion
		Neural Networks	
		Genetic Algorithms	SEAS
		Game Theory	
		Expert Systems	POFED
		Bayesian Updating	
Mid to Long Term	Intra-State	Social Network Analysis	PERICLES
		Artificial Intelligence	
		Statistical Models	COMPOEX
		Dynamic Modeling	
	Inter-State		Power Transitions

Tammen et al. 2000; Mearsheimer 2001; Lemke 2002; Doran 2003). Using equation-based dynamic modeling, most political theories (Richardson 1960; Intriligator and Brito 1984; Muncaster and Zinnes 1988; Saperstein 1994) at this level focus on indicators of national attributes and how those indicators interrelate. Here, a multitude of theoretical and empirical research exists (Zinnes and Gillespie 1976; Nicholson 1998; Brown 1995; Kadera 1995; Abdollahian 1996, 2008, 2009). Game-theoretical approaches (Schelling 1960; Powell 1987; Fearon 1994; Zagare and Kilgour 2000; Abdollahian and Alsharabati 2003) can be applied to any of the aforementioned, albeit, generally, with lower levels of fidelity unless highly tailored – and thus less generalizable – to a larger variety of political circumstances.

Of course, macro inputs, such as international events and government action, influence micro, or individual and group outcomes. Individuals, groups, and nations interact embedded in an environment that is defined, shaped, and constrained by macro dynamics of our political milieu. Changing national attributes, such as decreasing economic production or highly unstable political environments, can significantly alter micro-level interactions and even individuals' decision calculus. For example, during domestic political disturbances, decision time horizons of individuals as well as companies become shorter in the face of increasing uncertainty, driving more selfish behavior and eroding trust (Axelrod 1986).

A political modeler should account for the nexus between intra- and interstate dynamics that influence the decision calculus of the individuals and groups at the micro level and vice versa. While local political interactions of individuals are influenced by national and international conditions, the sum of those interactions can shape national and international conditions as well. Currently, there are good political models at the micro level (Bueno de Mesquita 1985; Kugler and Feng 1997; Rasler and Thompson 1994) and at the macro level (Grossman 1991; Fearon and Laitin 2002; Collier and Hoeffler 2004), but very few bridge the gap. For that reason, this chapter surveys political modeling theories from several subdisciplines in political science, spanning macrostructural theories of conflict, deterrence, war, and political economy to micro-level theories of political motivations and decision-making. While each of these literatures defines a portion of political interactions, together they outline the phenomenology of conflict and the boundaries of our current knowledge.

2 Theoretical Building Blocks

The first step in the construction of a political model is to select an appropriate theoretical foundation to inform and validate the underlying assumptions about the political behaviors to be modeled. A classification system to assess the applicability of various political theories is outlined to aid the reader. This system includes unit of analysis, model type, assumptions, key variables, structure of the environment, and the core logic of how the variables are related, in addition to main implications, empirical support, and shortcomings of these theories. Tables 2 and 3 describe several micro-, intra-, and international political theories and their relevant discriminating attributes.

Political phenomena occur in a multidisciplinary environment, including not only the specific political factors but also the economic, sociological, psychological, and even technological factors that can motivate political behavior. To explain terrorism or failed states, for example, one *single* political theory will not suffice. In the absence of any grand, unified field theory, analysts must combine best-in-breed theories. Theories are building blocks that researchers combine in various ways to model different political phenomena. In order to do so, the inputs and outputs of the theoretical blocks must be consistent and interlocking so that they can be combined in meaningful ways.

Once the foundation of a political model has been laid with the building blocks of theory, however, an analyst must determine what will be constructed upon that foundation. What is the artificial environment in which individuals, groups, or nations will interact? For example, the methodological engines that model individual behavior can be game theoretical (Intriligator and Brito 1984; Zagare and Kilgour 2000; Powell 1987), microeconomic (Schelling 1960; Fearon 1994), or rule-based expert systems (Bennett and Stam 2000; Abdollahian and Alsharabati 2003; Gilbert and Troitzsch 1999). If using a conceptual representation of political bargaining space, then theories such as the median voter theorem (Kim and Morrow 1992; Bueno de Mesquita 1980), subjective expected utility comparisons (Edwards 1996; Camerer and Lowenstein 2003), and Arrow-Pratt risk aversion (Pratt 1964) or Prospect Theory (Battalio et al. 1990; Cacey 1994; Kahneman and Tversky 1992; Levy and Levy 2002) are among many that are commonly used by political modelers. The next section examines some of the typical approaches for creating artificial environments or models in which political phenomena at the micro-, intra-, and interstate levels may be simulated and tested.

3 Key Approaches to Conflict and Cooperation

Below are surveyed a few of the typical best-in-breed political science approaches, detailed above in Tables 2 and 3. We first explore the macro analysis of conflict and cooperation by using nation-states as the unit of analysis to understand conflict behavior among and between nations. We then turn to a few main theories that

Table 2 Macro Theories and their attributes

	Classical Deterrence	Game Theoretic Deterrence	Dynamic Deterrence	Arms Race	Power Transitions	Endogenous Growth	POFED
Unit of Analysis	Nation State	Nation State	Nation State	Nation State	Nation State	Nation State	Nation State
Model Type	Structural	Microeconomics Individual Decision making Rational Choice	Microeconomics Individual Decision Making Rational Choice	Coupled Differential Equations	Structural Differential Equations	Formal Modeling Dynamic Equilibrium	Structural at the domestic level Dynamic general equilibrium model
Assumptions	Every response should be credible Every actor is rational	Nuclear war is so costly that only an irrational leader could consider it a means of conflict resolution	Every response should be credible Every actor is rational Risk averse individual is one who always prefers the expected value of a monetary gamble to the gamble itself while a risk loving individual has an opposite preference.	Deterministic Dynamic Rationality Utility Maximization	Hierarchy in the international system States are unitary & rational actors Status Quo & international hierarchy is based on relative power of state State power is based on domestic factors	Utility maximization Economic growth derived endogenously "Precisely" constant returns to scale in the production process	Individuals seek to maximize their lifetime utility by choosing how much to consume, save, and how many children to have Policy makers choose tax rate, amount of public investment, and military spending to maximize their chances or remaining in power

(continued)

Table 2 (continued)

	Classical Deterrence	Game Theoretic Deterrence	Dynamic Deterrence	Arms Race	Power Transitions	Endogenous Growth	POFED
Key Variables	Absolute cost of war	Individuals' preferences Individuals' choices in determining interstate conflict behavior	Missile stocks, Casualties, Rate of firing its missiles, Proportion of the counterforce attack, Proportion of counter value attack Effectiveness of missiles against enemy missiles Effectiveness of missiles against enemy cities	Missiles for two countries A and B and rates of change in missiles. Decision to launch missiles for country A and B Counterforce effectiveness: the ability to destroy the other nation's missiles. Counter-value effectiveness: the ability to kill the other nation's population.5. Casualties	Relative Power = GDP* Population* Political Capacity Status Quo Evaluations (satisfaction or dissatisfaction)	Capital Labor Innovation Human Capital Patent Laws (some)	Income: GDP per capita Fertility Human capital. Relative instability: Number of deaths in a given year relative to the maximum number of deaths in the country Political capacity: Ratio of revenues a government extracts compared to extract compared to predicted levels a society could attain based on economic endowment
Structural Environment	The cost of war is the key difference between the nuclear and pre-nuclear war. Nuclear arms races ensure peace.	Realism In a non-cooperative game: anarchy condition In a 2-persons game: bipolar international system	The cost of war is the key difference between the nuclear and pre-nuclear war.Nuclear arms races ensure peace.	Anarchy—no overarching authority to guide (or constrain) the individual collection of sovereign states.	Dominant nation at the top of international hierarchy Other nations under the dominant power Dominant power structures system to maximize its security	Interplay of economic and innovation factors	Interplay of political, economic, and demographic indicators anticipate the impact of interventions in fragile states

Core Logic	Nuclear arms races ensure peace\ Ultra stable solution can be reached through mutually assured destruction by proliferating nuclear weapons	Contrary to classical deterrence theory which finds key to interstate stability in the structure and distribution of power, game theoretical deterrence focuses on the interplay of preferences, choices in determining interstate conflict behavior, and outcomes.	A country chooses both a rate of fire and a targeting strategy either city or arsenal The 4 stages of nuclear deterrence strategies are: a. Conventional Balance of Power b. Massive retaliation c. Nuclear capabilities for two countries are equal but arsenal is not enough to assure retaliation. d. Mutually Assured Destruction	Arms races will lead to the "cone of mutual deterrence" based on the parameter estimates and nation's current weapons stock.	Power of a dominant state is overtaken by a challenging state Rise of populous, less developed state is inevitable Wars are most likely when nations are in parity and challenger is dissatisfied with status quo	Innovative firms generate knowledge: Knowledge is a public good which spills over into the economy as a whole resulting in increase in productivity. Technological Progress Formulation: Ensures the profitability of knowledge development to fuel innovation leading to increases in productivity.	Domestic factors such as fertility, income, and political effectiveness can lead to domestic instability leading to state failure

(continued)

Table 2 (continued)

	Classical Deterrence	Game Theoretic Deterrence	Dynamic Deterrence	Arms Race	Power Transitions	Endogenous Growth	POFED
Implications	Nuclear proliferation will stabilize the world politics.	Irrational and accidental wars are possible Nuclear powers are unlikely to fight when they are of roughly same size but disparity provides incentives to initiate a nuclear strike	Possibility of war exists only when costs are acceptable Path from Balance of Terror to Mutually Assured Destruction is unstable as one nation acquire nuclear weapons unilaterally	Arms races can have deterrent effects if nations have "run away" armaments that propel them into the "cone of mutual deterrence" or MAD.	Preponderance = peace Impact of relative power on the likelihood of war is conditioned by satisfaction or dissatisfaction within the international system	Differences in growth are maintained due to innovation Innovation is a function of production externalities Growth is determined by national differences	Economic fragility is self reinforcing Growth leads to stability creating further growth. Political capacity accelerates growth High rising capacity = stability Low & declining capacity = instability
Empirical Support	Brodie (1959): urged to turn our attentions from "Win-the-War Strategies" to "Deterrence Strategy" facing the era of nuclear warfare that is "too large-scale, too menacing to all our hopes. Waltz (1979) and Mearsheimer (2001): argues that if Mutual Assured Destruction is stable, expanding the scope of nuclear deterrence should dramatically reduce the likelihood of war whether contenders are large or small.	Schelling (1960): Chicken game captures realism and classical deterrence theory Fearson (1992): Crisis bargaining model shows that nations in adversarial relationships violate deterrence when one nation suggest possible use of threat Powell (1987): Mutual Assured Destruction is a cure all while failure of deterrence comes from random moves of nature Zagare & Kilgour (2000): Prisoner's dilemma better explains reality than chicken game.	Intriligator and Brito (1976, 1984): Path from the balance of terror to Mutually Assured Destruction is unstable as one nation acquires nuclear weapons unilaterally	Gilbert, Rider, and Hutchison (2005): The "arms race" variable has statistically significant, positive effect of the likelihood of military dispute. Also an arms race between strategic rivals does not facilitate deterrence, but instead facilitates war.	Organski & Kulger (1980): Nations equal in power are more likely to fight than nations with unequal power Lemke & Werner (1996): Study power and war of dyads including dominant nations Kim (1996): Status quo evaluations may be important in determining war than parity Abdollahian & Kang (2008)	Jones (1995): These theories have largely failed to perform empirically. Cavusoglu and Tebaldi (2006): The empirical work to date suggests that the "conditional convergence" hypothesis of the revised classical model seems to provide a more accurate empirical description of growth.	Feng, Kugler and Zak (2000): Provides overview of international dynamics that ferment domestic instability and lead to sate failure. Crossnationally validated for 78 countries and sub national level for 6 countries

Weaknesses	In order to achieve the "ultra-stable" nuclear world, proliferation optimists such as Mearsheimer and Waltz advocate a virtue of spreading nuclear weapons in unstable regions (Mearsheimer, 1990; Waltz, 1990).Waltz (1979) and Bueno de Mesquite and Riker (1982) suggest that, since nuclear weapons guarantee peace, more nations should acquire them.	Same as the weaknesses in classical and dynamic deterrence theories	Cost is the only critical factor in decision to engage in war Individuals' preferences are assumed to be the same Nations with or without nuclear weapon all have the same attitude of risk aversion	Little empirical support for this presentation of the theory outside of military buildups.	The logic of powerful therefore satisfied raises the question, If rising states are successful, why are they dissatisfied with the Status Quo? Prevention problem rises as myopic states forego a preemptive attack. There are critiques on when a war is most likely to occur during the transition process.	Lack of comprehensive empirical support	The approach cannot be applied effectively to states which have experienced total governmental collapse

Table 3 Micro Theories and their attributes

	Mediau Voter	Von Neumann & Morgenstern Utility Functions	Risk Propensity	Subjective Perceptions & Utility
Unit of Analysis	Individual Decision Maker	Individual Decision Maker	Individual Decision Maker	Individual Decision Maker
Model Type	Microeconomic Rational Choice	Microeconomic Rational Choice	Microeconomic Rational Choice	Microeconomic Rational Choice
Assumptions	Agent has a unique ideal point Single / multi Peaked Preferences 1-demensional choice space Sincere preference expression All agents are utility maximizers	State of nature: individual utility is dependent on underlying uncertainty & payoffs Gamble: decision making under uncertainty Lottery: individual choices denoted by p*x+(1-p)y	A risk averse individual in one who always prefers the expected value of a monetary gamble to the gamble itself while a risk loving individual has an opposite preference.	Contrary to von Neumann-Morgenstern theory, probabilities are assumed as "subjective" numerical frequencies based upon individuals perceptions
Key Variables	Constituents' preference Politicians Political parties Election rules Electoral institution	Probability Utility Risk Propensity	Probability Utility Risk Propensity	Probability Utility Risk Propensity Perceptions

Structural Environment	Democracy or any majority rule voting system	Investigates the motives of an agent decision-making under uncertainty & risk	Neumann-Morgenstern & Friedman and Savage (1948) constructed the concepts of utility and univariate risk propensity in seeking the ways of analyzing economic issues with expected utility framework.	Investigates the motives of an agent decision-making under uncertainty & risk according to subjective probabilities
Core Logic	In a majority election, where two politicians commits to policy position closest to his own preference, if the politicians want to maximize the number of votes, they race to the median to win If either candidate deviates to a different policy position, the deviating candidate receives less than half the vote.	The individual's expected utility of a gamble is represented as V=E(u(w))=pu(w1)+(1-p) u(w2) The expected value of gamble is represented as u(E(w))=u(pw1+(1-p)w2)	The individual's expected utility of a gamble is represented as V=E(u(w))=pu(w1)+(1-p) u(w2) The expected value of gamble is represented as u(E(w))=u(pw1+(1-p)w2) If the former is smaller than the latter, such behavior is called risk aversion. If the former is larger than the latter, such behavior is called risk acceptant.	Similar to Utility & Risk but perceptions drive subjective estimates

(continued)

Table 3 (continued)

	Mediau Voter	Von Neumann & Morgenstern Utility Functions	Risk Propensity	Subjective Perceptions & Utility
Implications	Majority rule voting system is imperfect and failures exist on many levels Each and every election mechanism produces its losers and inefficiencies so its only a trade off of inefficiencies Democracy has a danger of producing a leader without much support Politicians and political parties gather to the median to maximize their votes	The expected utility property says that the utility of a lottery is the expectation of the utility from its prizes. We can compute the utility of any lottery by taking the utility that would result from each outcome, multiplying that utility times the probability of occurrence of that outcome, and then summing over the outcomes. Utility is additively separable over the outcomes and linear in the probabilities.)	The utility of the expected value is higher than the expected utility of the gamble, so the agent is risk averse. A level of certain wealth provides the same utility as does participating in his gamble. The individual will be willing to pay anything up to some value to avoid participating in the gamble. Even when costs are paid, this riskaverse person is as well off as he would be if forced to face the world uninsured.	If an individual's behavior satisfies restrictions sufficient to ensure the existence of subjective probabilities, those probabilities must satisfy Bayes' law. Bayes' law is important since it shows how a rational individual should update his probabilities in the light of evidence, and hence serve as the basis for most models of perceptual and rational learning behavior. Misperceptions between individuals' subjective estimates can drive different behavior.

Empirical Support	Black (1948): Stated that political parties will pursue policies that appeal the most to median voters Downs (1957): Introduced left-right axis to economic theory. He claimed that as voters do not have perfect information regarding the candidates, voters will resort to economic issues	von Neumann and Morgenstern (1944): Investigated the motives of an agent making a decision under risk. By defining a real-valued preference function over the set of cumulative functions, enables us to model agent preference over alternative probability distributions in a manner completely analogous to non-stochastic decision making theory.	Bueno de Mesquita (1985): Computed hypothetical risk scores by sampling 30,000 configurations per year and selecting the global minimum and maximum from this search as the hypothetical minimum and minimum for all states. Kim and Morrow (1992): Showed rising state's risk attitude is increasing while declining state's risk attitude is decreasing Tversky & Kanaheman (1979) show opposite results in Prospect Theory.	Knight (1921): Proposed distinguishing between risk and uncertainty according to whether the probabilities are given to us objectively or not. In a sense, the theory of subjective probability nullifies this distinction by reducing all uncertainty to risk through the use of beliefs expressible as probabilities. Theory is therefore a far-reaching generalization of expected utility theory.

(continued)

Table 3 (continued)

	Mediau Voter	Von Neumann & Morgenstern Utility Functions	Risk Propensity	Subjective Perceptions & Utility
Weaknesses	Majority rule decision mechanism reveals a failure of at least one type of inefficiency No one majority rule mechanism fully reveals preference of the voters The non-verification of single peaked preference can lead to majority cycle trap where agenda maker has the power to choose any outcome by manipulating the order of propositions	Violations of interpersonal comparisons of utility Must estimate objective probabilities No possibility of misperceptions	There is no measurement to capture the degree of agent commitment with its direction. The game structure is strictly non cooperative. Decision makers do not make binding, strictly enforceable commitment to the status quo. The incidence of conflict between agents is over-predicted	Violations of interpersonal comparisons of utility Must estimate subjective v. objective probabilities

explain the nation-state itself and how its economic factors, demographics, and other national indicators can lead a nation to war or peace. Finally, several key theories that drive micro-, individual-level behavioral dynamics will be mentioned to explain how preference, behavior, and perception of individual leaders in a nation can be combined to anticipate politics, peace, or conflict.

3.1 Macro Interstate Approaches

One of the earliest models of relations between states was the so-called arms race model originally introduced by Richardson (1960). Such models investigated the dynamics of nations' armament buildups by using coupled differential equations. Richardson's equations posit a simple deterministic relationship between two states based on action and reaction, in which a small buildup by one side would lead to a larger counter by the opponent. Thus, an arms race could produce a wide gap in capabilities; this gap in capabilities was expected to prompt conflict. The equations define a precise movement of armaments through time, in which the pace of armament or disarmament is a function of how far one nation is away from its long-run equilibrium point. Depending on the initial conditions, the equilibrium can be peace or war. An "equilibrium point" in a dynamic system is a solution for the equations that does not change with time. The "initial condition" is the value of the variables at the onset of the simulation. Thus, the rate of armament buildup is expressed as:

$$\mathrm{d}x / \mathrm{d}t = ay - bx + g$$

$$\mathrm{d}y / \mathrm{d}t = cx - dy + h$$

where

1. $\mathrm{d}x/\mathrm{d}t$ (for nation x) and $\mathrm{d}y/\mathrm{d}t$ (for nation y) are the rates of armament
2. x and y are the amount of armaments
3. a and c are "threat" parameters
4. b and d are "fatigue" parameters
5. g and h are "grievance" parameters

Based on the value of the model's parameters, the nations experience either "runaway" (i.e., unchecked) armament or disarmament (based on the model's initial conditions) or convergence at an equilibrium point. Stability in the system is determined by whether states place relatively more emphasis on the threat of the other nation's arms or on fatigue from armament buildup and expenditure. Although the Richardson model represents only an early attempt to simulate and predict political behavior, his work influenced later scholars.

A major extension of this perspective led to the evolution of deterrence theory at the macro interstate level. One of the cornerstones of deterrence theory was laid early in the Cold War by Brodie (1959), who urged a focus on deterrence rather than victory, as nuclear warfare is "too large-scale, too menacing to all our hopes." The

expectation that nuclear terror can credibly compel potential opponents to avoid confrontations is rooted in the high cost of nuclear war; thus, the implication of deterrence theory is that nuclear arms races ensure peace. This classic notion behind Mutually Assured Destruction (Huth and Russett 1990; Waltz and Sagan 1995) – that nuclear proliferation leads to highly stable international conditions – was refined by deterrence scholars such as Intriligator and Brito (1981). They assume that when nations anticipate that the costs of war will exceed a threshold above which said nations are not willing to initiate conflict, nations will fight only in self-defense. When a second threshold is exceeded, a nation is no longer willing to confront the opponent, and that nation will be deterred from war or yield to the aggressor's demands. Therefore, the possibility of war exists only when costs are "acceptable." Unstable conditions occur when contending actors have only conventional capabilities and cannot impose sufficient costs to deter opponents. In their research, this scenario is divided into four stages. The first is called the "Cone of War," in which nuclear parity stabilizes world politics. Second is "Massive Retaliation," in which one side initiates a nuclear buildup. Third is the "Balance of Terror," in which both nations have nuclear capabilities, but their arsenals are not large enough to assure retaliation if the other side attacks preemptively. This stage is tenuously unstable, until a credible second-strike capability is developed. The fourth and final stage is "Mutually Assured Destruction," in which equality of nuclear capabilities and secure second-strike capabilities on both sides minimizes the likelihood of war because the costs become unacceptably high. The basic model is as follows:

$$\mathrm{d}M a / \mathrm{d}t = -\alpha M a - \beta' \beta M b \times fb$$

$$\mathrm{d}M b / \mathrm{d}t = -\beta M b - \alpha' \alpha M a \times fa$$

$$\mathrm{d}C a / \mathrm{d}t = (1 - \beta')\beta M b \times vb$$

$$\mathrm{d}C b / \mathrm{d}t = (1 - \alpha')\alpha M a \times va$$

where:

Country: a, b
Initial time: $t = 0$
M(t): missile Stocks
C(t): casualties
α, β: the rate of firing a country's missiles
α', β': proportion of counterforce (against enemy missiles) attack
$(1-\alpha')$, $(1-\beta')$: proportion of counter value (against enemy cities) attack
f: effectiveness of missiles against enemy missiles
v: effectiveness of missiles against enemy cities

The implication of dynamic deterrence is that during the development of nuclear capabilities, one nation cannot fully deter the other and war is possible. It is in the last stage at which mutual destruction is assured that the cost of war prevents both nations from initiating war. As one nation acquires weapons unilaterally, however, the path to the last stage is very unstable. Deterrence is therefore

not entirely stable; additionally, because terrorists and other violent nonstate actors do not have a "return postal addresses," deterrence is not credible toward such threats. Deterrence is the ability to prevent attack by a credible threat of unacceptable retaliation. The calculation of the cost of war is the main rationale in deterrence; thus, the theory is difficult to apply to violent nonstate actors. One nonobvious insight from the Intriligator and Brito theory is that a strategy that assures retaliation and minimizes communication among contenders may produce conflict.

Organski (1958) proposed that nations would fight when they are dissatisfied with international norms and hold equal capabilities. This is based on the assumption that hierarchy exists in the international system. Here, hierarchy is defined as a system in which a dominant nation (the "defender" or "dominant power") is at the top of an international power hierarchy, with "great powers," "middle powers," and "small powers" under the dominant power. In this power transition theory (PTT), power is measured relatively (in comparison to other states) based on demographic and industrial indicators, where Relative Power = GDP × Population × Political Capacity where Political Capacity measures the state's domestic control, a ratio between anticipated and actual tax receipts. Additionally, the dominant power enforces the status quo of the international system, while lesser powers are either satisfied or dissatisfied with the status quo.

PTT anticipates interstate dynamics by analyzing this relative power distribution across the international system and the member's satisfaction with the status quo. Under conditions of parity and dissatisfaction, the theory predicts the highest probability of international conflict; when nations dissatisfied with the status quo accrue enough power to challenge the dominant nation, PTT postulates that war is most likely. For example, in the middle of the Cold War, a PTT-based analysis (Organski and Kugler 1980) concluded that the conflict in Europe would not be repeated because of integration, that the USSR would fall from the rank of competitors by 2000, that China would emerge as the leading challenger to the United States, and that the political center would shift from the West to Asia by the end of this century. The dominant power is committed to defending the international treaties and norms that constitute the status quo, which reflects the dominant power's preferences (as it is the most powerful nation within the international hierarchy).

Using a system of symmetric, coupled nonlinear differential equations, Abdollahian and Kang (2008) formalized and tested a system-dynamic model to identify to what extent and degree policymakers can maintain stability in rival dyads, such as the U.S.–China case. Their model explores some of the structural conditions of how conflict or cooperation affects the growth and transition from the PTT literature. The work suggests specific, strategic policy prescriptions for managing conflict or cooperation and highlights the nonlinear and nonmonotonic effects of foreign policy actions.

The entire power parity model system of nonlinear ODEs is the combination of the following equations:

$$\frac{\mathrm{d}P_{\mathrm{D}}}{\mathrm{d}t} = B_{\mathrm{D}}P_{\mathrm{D}}\left(1-\left(P_{\mathrm{D}}+P_{\mathrm{C}}\right)\right)-H_{\mathrm{D}}C_{\mathrm{C}}$$

$$\frac{dC_D}{dt} = -S_D P_D C_C \frac{1}{\sqrt{2\pi\sigma}} \exp - \frac{1}{2}\left(\frac{P_D / P_C - 1}{\sigma}\right)^2 \frac{1}{2.50599}$$

$$\frac{dP_C}{dt} = B_C P_C \left(1 - \left(P_D + P_C\right)\right) - H_C C_D$$

$$\frac{dC_C}{dt} = -S_C P_C C_D \frac{1}{\sqrt{2\pi\sigma}} \exp - \frac{1}{2}\left(\frac{P_C / P_D - 1}{\sigma}\right)^2 \frac{1}{2.50599}$$

where:
P_D is the systemic power level of the dominant nation.
P_C is the systemic power level of the challenger.
B_D is the national growth rate coefficient of the dominant nation.
B_C is the national growth rate coefficient of the challenger.
H_D is the dominant nation's cost coefficient for competition.
H_C is the challenger's cost coefficient for competition.
C_C is the conflict level that the challenger targets toward the dominant nation.
C_D is the conflict level that the dominant nation targets toward the challenger.
S_D is the foreign policy stance of the dominant nation toward the challenger.
S_C is the foreign policy stance of the challenger toward the dominant nation.
σ is the parity variance condition coefficient.

The variables in the power parity model include systemic power levels, conflict levels, foreign policy stances, and the value of the parity ratios for a rival dyad. The parameters in the power parity model are the national growth rates, the cost of competition, and the parity variance condition. By varying the parameter values and initial conditions of variables for rival dyads, an analyst can explore the performance of the dynamic model under various circumstances, not only reconstructing historical relationships between dyads but also forecasting simulations. Figure 1 demonstrates the policy results using U.S.–China data (Abdollahian and Kang 2008).

Figure 1 depicts a scenario in which China adopts a highly hostile foreign policy stance ($s_c = -0.9$), and the U.S. policy response is allowed to vary. Notice that at aggressive U.S. foreign policy response values, the effects of competition on systemic power levels produce a significant, detrimental impact on both countries. As the United States begins to question the rise of China, small changes in the firming of the American policy stance produce sharp increases in dyadic conflict. Hence, the structural stage is set for prompting early conflict initiation and war escalation. At the other extreme, an acquiescent foreign policy stance toward China produces sustainable levels of systemic power for a while, although a Chinese overtaking is guaranteed within about 15 years. In this case, after China surpasses the United States in systemic capabilities, possible minor conflicts or hostile incidents are still expected between the two countries. At a neutral foreign policy stance, levels of U.S. conflict remain low throughout the transition period as a result of small changes in the U.S. conflict equation. Under these simulation conditions, only a neutral U.S. policy stance can secure the window of opportunity for peace and stability.

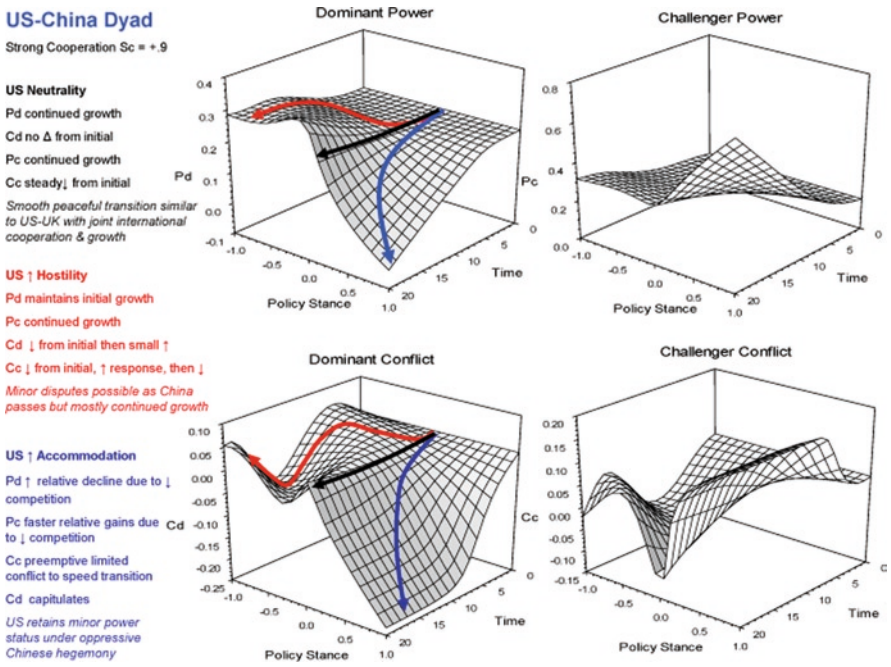

Fig. 1 U.S.–China dyad

3.2 Macro Intrastate Approaches

The systematic empirical research on *intrastate* and *nonstate* conflict has a very long and distinguished record based on innumerable case studies and a vast array of alternative propositions accounting for the rise of nation-states and the emergence of institutions and dissatisfaction in the polity (Brinton 1952; Crenshaw 1995; Huntington 1968; Gurr 1974; Diamond 1992; Inglehart 1997; Welzel et al. 2003). These contributions span the fields of not only political science and economics but also sociology and cultural anthropology. Tilly (1975) in a classic assessment and Poggi (1990) summarize systematically the process of state formation. Barnett (2004) links the motivations of international terrorism to economic modernization of states. Lemke (2009) shows that when a nation emerges from a cooperative aggregation of states – such as the unification of the Italian states in the nineteenth century or expansion of the United States – that legacy leads to relatively stable and evolving governance. On the other hand, when the birth of a nation or its reconstruction is associated with serious conflict, insurgencies and developmental lags are introduced. Nation-building propositions can profit from such long-term assessments, but understanding the political motivations and mechanisms, let alone modeling causation, remains submerged in such summaries. For a recent general review, see Midlarsky (2009).

Davies (1962) was among the first to systematically relate insurgency with an inverse U curve of development. He demonstrated that internal instability was not likely among the least and most developed societies but maximized among the less developed societies, particularly those undergoing fast economic development. A large related literature subsequently developed relating opportunity to the likelihood of insurgency to predict conflicts based on the economic and political incentives or constraints they face (Grossman 1991; Collier and Hoeffler 2002, 2004; Elbadawi and Sambanis 2002; Fearon and Laitin 2003; Fearon 2004; Barnett 2004; Hegre and Sambanis 2004; Abdollahian et al. 2009). A number of explanatory variables, including ethnicity, culture, absolute deprivation, language, and race are discarded, while economic well-being, the strength of political institutions, and reliance on commodity exports – mainly oil – are consistently associated with conflict. Thus, affluent societies that have institutionalized effective governance, and do not rely on exports of commodities such as oil, are least likely to experience insurgencies. Unfortunately, this literature is, however, confounded by the lack of reliable and consistent historical data for most countries. The revival of interest in insurgency studies in the early 2000s refocused researchers on how nonstate actors can generate intrastate instability. Previous studies had demonstrated a very weak link between civil war and the initiation of international conflict (Tanter 1966; Rosenau 1964), and for that reason much of the earlier research focused on intrastate conflict at the state-society level. Demands to link intrastate with substate actors and interstate conflict forced most researchers to rely on national rather than subnational data for their exploration. Collier and Hoeffler (2004), for example, show that "greed" rather than "grievance" is associated with the initiation of intrastate conflicts. The causal relation from "grievance" and "dissatisfaction" to domestic instability is established but not directly related to the source of conflict. The concern here is that substate actors and their representative populations that have "grievances" or are "dissatisfied" with fiscal performance or political governance are not directly identified. Rather, differences across nations help to determine the likelihood of intranational instability. Buhaug and Gates (2002) among others challenge such results showing that applying aggregate measures says little about whether conflicts are located in these areas. This leaves a void where integration of political models across levels of analysis can help.

A second major contribution to the emerging understanding of intrastate instability is driven by the contribution of Fearon and Laitin (2003) that found, contrary to most case study results, little relation between conflict and ethnic, religious, linguistic, or cultural differences. Instead, they show that rough conditions identified by Guevara (1968) are cross-national correlates of insurgency and guerrilla activity. Based on these aggregate results, geography and the flow of populations are used to explain intrastate conflict (Hendrix and Glaser 2007; Salehyan and Gleditsch 2004). The standard argument is that rough terrain confers tactical advantages on insurgents by mitigating the advantages enjoyed by state armies, which can mobilize disenfranchised groups to rebel. Outnumbered and outgunned insur-

gents can avoid direct engagement and gain access to safe havens where they can recruit and replenish supplies. Collier and Hoeffler (2002) find that mountainous, forested terrain aids in insurgencies. Likewise, Fearon and Laitin (2003) find a significant positive relationship between rough terrain and the onset of conflict. Most likely, climate and terrain provide the preconditions for effective insurgencies but are not and cannot be the variables that *cause* intrastate conflict as geography does not significantly vary over time. Raleigh (2004) is right on point when he challenges the aggregate approaches, arguing that modern insurgencies are as likely to be based in urban areas as rural ones that provide excellent safe havens. Moreover, safe havens in neighboring states where porous borders exist would make rough terrain irrelevant. He argues that weak states, defined as those with low GDP per capita and weak political institutions, are limited in their ability to project political authority regardless of terrain. Fragile states rather than geography place governments at risk, and this is shown in more recent work that suggests economic, demographic, natural resources, and political factors trump geographic variables (Humphreys 2005). Controlling for these foreign safe havens and economic and political development shows that rough terrain, as defined by Fearon and Laitin (2003), is not a significant predictor of conflict onset (Bahaug 2002, 2004; Rodrik 2004; Engerman and Sokoloff 2002).

Recent work focuses on the causes of domestic instability as based on insights from the long case study record and on intrastate and stakeholder data that emphasize *differences within* a national unit. Cederman (2004) links ethnic groups that inhabit mountainous terrain suggesting national formation. Using agent-based modeling techniques, he finds that violent separatist movements are much more likely to occur in mountainous terrain and tropical climates that provide shelter for guerrilla activities when ethnic groups are hierarchically organized and not otherwise. This type of approach to identify the pathways of a nation moving down the road to intrastate conflict requires a detailed, subnational level analysis at the provincial, district, or individual level. Our approach starts with the respecification of successful models that account for international conflict at the intrastate level.

3.2.1 Applications: Relative Political Capacity

For a detailed example, we first examine a key political indicator of relative political capacity and then explore one structural model of domestic political economy called the Politics, Fertility, and Economic Development model [POFED] (Feng et al. 2000). Relative political capacity (RPC) is the ability of a government to extract resources from its population as evidenced by relative performance of actual versus expected tax collection efforts for a given level of economic development (Arbetman and Kugler 1997). Recent work (Arbetman and Johnson 2008) on the dynamic effects of changes in political capacity suggests that as a government loses its ability to extract resources and advance its goals, the potential for competitors willing to fill that gap rises. Unexpectedly, as the political capacity of the challenger rises, a competitor usually replaces the government. If the competitor gains footing, the political

capacity rises anticipating the lowering in instability. When the new government establishes control and achieves normal levels of political performance, this cycle of instability comes to a close. The pattern suggests a relationship between a government's level of political capacity, changes in the level of political capacity, and intrastate instability. Not only do the levels of political capacity matter but also the rates of change as shown in Fig. 2.

Here, we see political capacity changing from positive to negative, in both level and rate, from 1996 to 2005 for a particular nation with the associated size of participants in demonstrations and those killed or wounded in such (Kugler et al. 2008). Disaggregating political capacity to the provincial level within nations shows even more clearly the areas from which a national government will be challenged. Arbetman and Johnson (2008) show that without a strong central government presence, provincial governments face a political challenge from groups that are themselves capable. Such information is essential in assessing to what degree providing economic assistance to an area – such as Darfur in Sudan – would limit casualties without destroying the central political foundations required for continual stability.

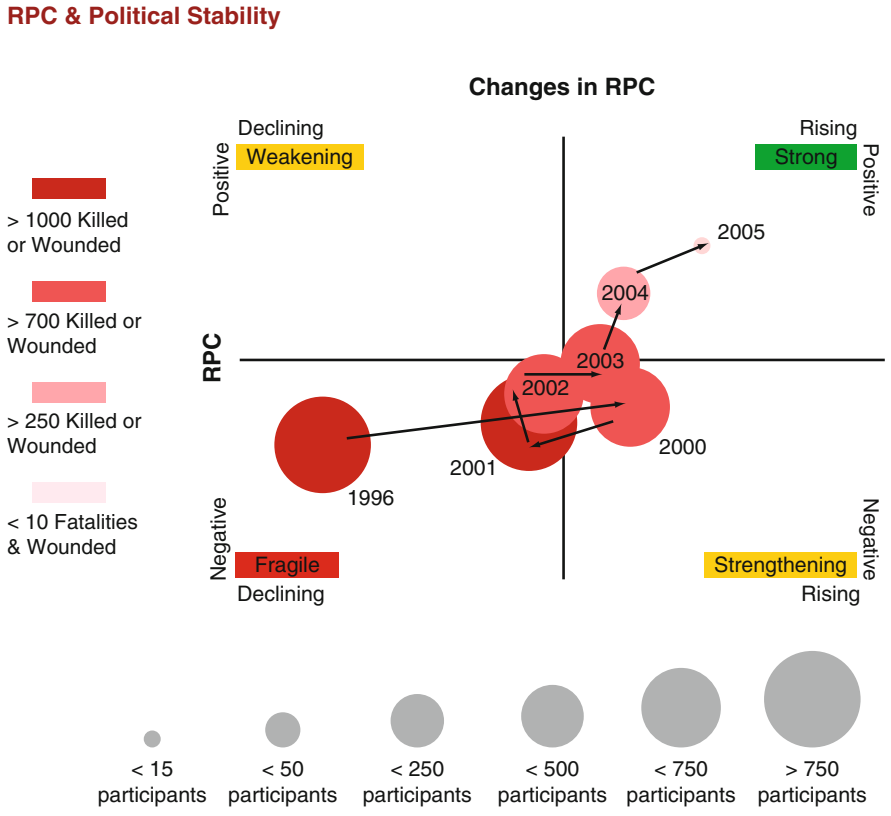

Fig. 2 Political capacity

Clearly, instability results from the interaction between economic growth and political capacity, so the linkages between political capacity and domestic political economy are crucial. Here, we look at an example of a structural model of detailed domestic intrastate politics, POFED which highlights the effects of growing political resources, economic constraints, and demographic pressures on the promulgation of conflict (Feng et al. 2000; Kugler et al. 2005). The model grew out of extant literature on modernization, human capital formation, institutional capacity, and economic development as a means of tracing the dynamic interrelationships between productivity, fertility, political effectiveness, and social stability. By using a statistically validated system-dynamics approach for the behavior of individuals and policymakers in a dynamic world focusing on antecedents for state failure and insurgency, POFED accounts for the political and economic structural environments that cause a country's living standards and political position to grow or decline.

The interplay of political, economic, and demographic indicators is modeled in POFED to anticipate the impact of interventions in fragile states and can thus be used to identify direct policy levers to mitigate state fragility. In addition to identifying policy, investment, and business actions that impact structural conditions to decrease state fragility, POFED can provide detailed tactical leverage points when applied at higher geospatial resolutions, such as provincial or district level analysis. As shown in Fig. 3, POFED has five major components that capture factors of state fragility and the effects of potential intervention: Income (y), Fertility (b), Human Capital (h), Instability (S), and Political Capacity (X). POFED is a dynamic general-equilibrium model based on the intersection of political and economic maximization function. The models show maximizing behavior of individuals seeking to maximize their lifetime utility by choosing how much to consume and save and how many children to have, while policymakers choose the tax rate and the amount of public investment and military spending to maximize their chances of remaining in power. In equilibrium, prices move endogenously so that supply balances demand for all goods and investments in the economy, while policymakers set fiscal policies. Further, the political-economic market equilibrium is a dynamic curve in the phase space tracing the evolution of the political-economic system. The model is specified as:

$$b_t = By_t^{-1}$$

$$y_{t+1} = Ay_t^{\eta}(1 - S_t)^{\alpha}\chi_t^{1-\alpha}h_t^{1-\alpha}$$

$$h_{t+1} = \omega h_t / b_t^{\theta}$$

$$S_{t+1} = S_t^{a} d\chi_t(\chi_{t-1} / \chi_t)$$

$$\chi_{t+1} = Cy_t^{\gamma}\chi_t^{\beta}p_t^{\phi} / b_t^{\gamma\phi}$$

These equations show that birth rates b depend on income y; and that income depends on past income and political conditions, x. h shows the generational feedback on the creation of human capital, while political instability, S, has a temporal feedback

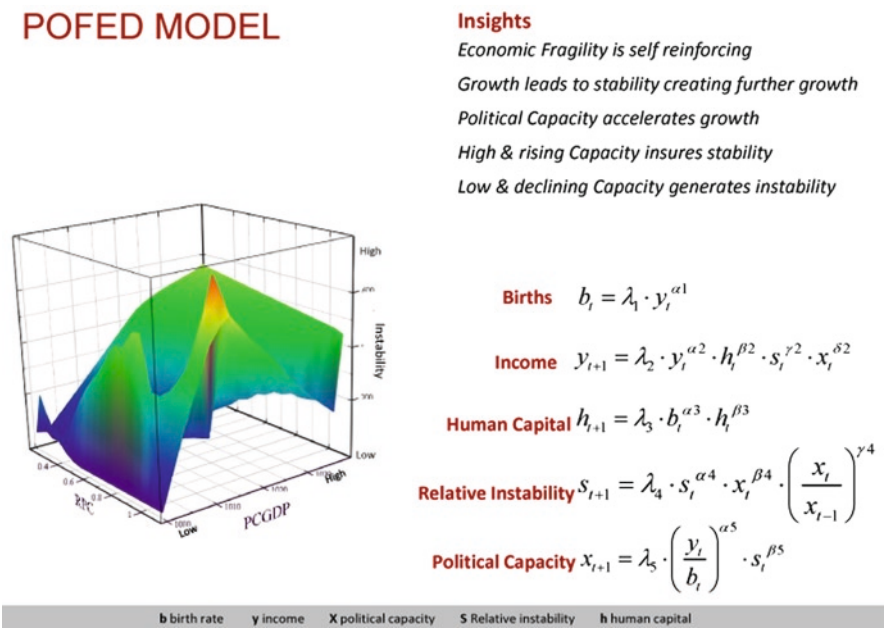

Fig. 3 POFED model components

and depends on external policy p_s. Similarly, political capacity, x, depends on per capita income y, external policy p, and births b.

The intuitive logic of POFED is as follows. In addition to well-established economic determinants, the fundamental political variable of political capacity alters fertility decisions, human capital accumulation, and economic development. In fact, fragile developing societies are defined by a decline in per capita income, by the potential for falling into the poverty trap, and by the low or declining capacity of governments (Guillaumont and Jeanneney 1999, Kugler and Tammen 2010). Robust societies with higher levels of political capacity extract more than anticipated from their economic endowment and allocate such resources efficiently to advance the government's priorities; fragile societies that fall below average political capacity levels of similarly endowed societies fail to do so. Some of the key general policy prescriptions are summarized as follows:

- Sufficient political capacity is a necessary precondition for income growth for poor countries.
- Income growth is self-reinforcing: when birth rates fall, human capital rises and political instability declines.
- The poverty trap is self-reinforcing; when birth rates rise, political instability increases and income falls.
- External aid, policy interventions, and domestic policies can increase stability and promote income growth.

- Increasing political capacity and change in political capacity reduce political instability.
- Income falls and birth rates rise when political capacity is lower and political instability is higher.
- There are thresholds of political capacity and political instability driven by economic performance that can cause a state to fail.

3.3 Micro Individual Approaches

The preceding sections have examined how conflict and cooperation between, among, and within nations can be modeled based upon structural theories using the nation-state as the unit of analysis. The effects of structural variables, such as fertility, unemployment, or public opinion, on political outcomes, however, are often realized gradually over time. If the analytical question being modeled concerns the near future, or if modeling the subnational interactions of individuals or groups, then a micro-level theoretical approach is best applied.

The major difficulty in the political analysis of individuals is that human behavior is inherently difficult to predict, and we are all different from diverse cultures, religions, and political persuasions. Thus, our political preferences are not universal. Although physical security is the fundamental objective of all states, the relative priority of policy considerations ancillary to security differs widely between societies and between individuals. The deeper analytical challenge, however, is in modeling not only the competition between individual preferences, but also the origin of those preferences. For instance, how do individuals order their political preferences in the face of risk? How do individuals determine the utility of different actions amidst uncertainty? Focusing on individuals as primary actors in policymaking, several theories of microeconomics have been employed for micro-level modeling under the rubric of positive political theory. For example, the idea that risk and uncertainty may play a pervasive role in economic analysis was originally suggested by Frank Knight in his 1921 study of insurance markets. In *Risk*, *Uncertainty*, *and Profit*, Knight observed that the distinction between risk and uncertainty was based on whether risk can be expressed in a specific mathematical probability. If so, then risk becomes insurable, and if not, it becomes an unmeasurable probability (i.e., uncertain). This notion has also been incorporated into the study of political modeling, leading to explanations of differences between individuals' calculations about the utility expected from taking certain actions.

Jonn von Neumann and Oscar Morgenstern (1944) investigated the motives of an individual making a decision under risk in the *Theory of Games and Economic Behavior*. In their theory, individuals are assumed to be facing a "choice set" of alternative probability distributions (or, in another expression, lotteries). Von Neumann and Morgenstern enable us to model the agent's preference over alternative probability distributions by differentiating between a gamble and a lottery. In a state of nature, an individual's utility is dependent on

uncertainty as well as on the monetary payoffs. However, under uncertainty, the decision-maker is forced into a gamble in which it is impossible to ensure that every decision maximizes his utility. Conversely, a lottery enables individuals to calculate the probabilities assigned to choice. A simple lottery is denoted as follows:

$$p \times x + (1 - p) \times y$$

The above equation can be translated as "the individual receives prize x with probability p and prize y with probability $(1-p)$." The prizes may be money, bundles of goods, or even further lotteries. The expected utility property says that the utility of a lottery is the expectation of the utility from its prizes. We can compute the utility of any lottery by taking the utility that would result from each outcome, multiplying that utility times the probability of occurrence of that outcome, and then summing over the outcomes. However, when the probabilities are assumed to be subjective instead of objective, then probabilities are degrees of belief in a proposition rather than a set of events that is inherent in nature. Thus, individuals should update the calculation of probabilities in light of evidence. Bayes's theory of subjective probability nullifies Knight's distinction by reducing all uncertainty to risk through the use of beliefs expressible as probabilities (Earman 1992). This theory argues that even if states of the world are not associated with recognizable, objective probabilities among gambles, decision-makers still behave as if utilities were assigned to outcomes, probabilities were attached to states of nature, and decisions were made by taking expected utility.

After the axiomatization of the expected utility hypothesis by von Neumann and Morgenstern, Milton Friedman and Leonard Savage (1948) advanced the concept of univariate risk propensity by analyzing economic issues within an expected utility framework. The spectrum of risk (with risk aversion at one end and risk acceptance at the other) is demonstrated once again by a gamble. For risk-averse individuals, the utility of the expected value (i.e., the "ante") is higher than the expected utility of the gamble due to the inherent risk of loss. A level of certain wealth provides the same utility as does participating in this gamble. We call this the "certainty equivalent" of the gamble: the amount a person would take for certain rather than play the gamble. The individual will be willing to pay anything up to some value relative to the ante to avoid participating in the gamble. We call this the "risk premium," the amount that a person would pay to avoid playing the gamble. This explains why people buy insurance. Even when these costs are paid, the risk-averse person is as well off as he would be if forced to face the world (or the gamble) uninsured. At the opposite end of the spectrum is the risk-loving individual who prefers a lottery to its expected value.

Kahneman and Tversky (1979), however, showed that individual decisions are made evaluating gains and losses separately rather than in consideration of aggregate totals. This occurs because people perceive improvements or deterioration in their welfare differently; individuals may also misperceive the probabilities underlying their decisions. The two main propositions of this theory are (1) that individuals make decisions based on changes in wealth rather than their total wealth (which

is in direct contradiction to expected utility), and (2) that risk aversion does not universally prevail, as some individuals are risk-seeking regarding loss.

The perception of utility in risk assessment demonstrates how expected utility theory can be applied to models of decision-making amid uncertainty. Bueno de Mesquita (1985) asserts that once a crisis develops, calculations of net gain accurately account for the escalation and termination of disputes. He shows that once a crisis starts, the analysis of a nation's net gains by an individual leader distinguishes between asymmetric and symmetric wars, anticipates when wars will be limited and when they will escalate, determines when confrontations will remain bilateral and when they will become multilateral, and indicates how a war will terminate.

One approach to modeling political phenomena amidst the uncertainty produced by competition between individuals with diverse preferences is the "stakeholder" family of models. Stakeholders are individuals who either have the power to influence an outcome of a decision or are deeply interested and thus active in an issue. Stakeholder models assume that individuals are "utility-maximizing rational agents" – in which utility-maximizing means that individuals will seek to enact their preferences, and rational means that those preferences are ordered (i.e., outcome A > outcome B > outcome C). One of the earliest predictive stakeholder approaches was the Prince model, originally constructed by William Coplin and Michael O'Leary (1972). A rational agent model, Prince attempts to predict political events based on the interests of the parties significant to the outcome of the event. The Prince model requires an informed observer to evaluate the orientation toward certainty of position regarding, power over, and salience of an issue to stakeholders capable of influencing event outcomes. This pencil-and-paper model lacks the fidelity of later extensions, but it was the first reasonable way to diminish uncertainty regarding the outcomes of political competition between individuals and their respective policy preferences.

3.3.1 Senturion: A Micro Dynamic Model of Politics

Several of the approaches discussed in previous sections have been formalized into dynamic or computational models (Bueno de Mesquita 1985; Bueno de Mesquita and Stokman 1994; Kugler and Feng 1997). Here, we discuss in detail one example of such an approach, Senturion (Abdollahian et al. 2006), a tool that can help policymakers and analysts predict political events and anticipate domestic or international political stability levels, as well as analyze specific investment decisions in which political matters affect outcomes. Senturion is a simulation system that analyzes the political dynamics within local, domestic, and international contexts and predicts how the policy positions of competing interests will evolve over time. The underlying methodology relies on several micro-level theoretical blocks. The set of rules used by Senturion synthesizes several classes of political science and microeconomic theories drawn from game theory, decision theory, spatial bargaining, and microeconomics. Unlike a statistical or probabilistic approach to predictive modeling, Senturion employs a set of micropolitical algorithms in sequence. Each

theory provides a functional component for modeling how agents interact to model the "pulling and hauling" of political processes.

Given a particular issue, such as the attitude of stakeholders toward providing government-subsidized health care or the attitude of stakeholders toward U.S. military operations in Afghanistan, the Senturion approach facilitates subject matter expert (SME) identification of the positions of critical stakeholders on policy issues, weighs their potential influence, and assesses the strength of their commitment or advocacy of a policy position. This SME-generated data input captures a *snapshot* of the current political landscape. Given a particular landscape, several theoretical building blocks are useful to simulate complex human behavior and animate that landscape forward for predicting politics. We can build models of "heavy" agents, those with several initial political attributes, with the following six qualities adapted from Gilbert and Troitzsch (1999):

Knowledge and beliefs: Agents have priors on the political environment in which they are situated. In the Senturion approach, the initial data on the political landscape generated by stakeholder attributes, such as opponents' and supporters' policy positions and potential to influence, is known among all other stakeholders (Coplin and O'Leary 1972).

Inference: Agents can also make inferences from their knowledge about which potential actions to take and which ones are more credible than others as well as anticipating how other agents will react. Here, notions of risk are used to drive potential misperceptions of agent inferences, as social modeling necessitates the inclusion of political perceptions and misperceptions.

Social models: Senturion uses the notions of Black's political median (1958), Arrow-Pratt risk aversion (Pratt, 1964), and game-theoretical models (Bueno de Mesquita 1985; Lalman and Bueno de Mesquita 1989) to model various types of stakeholder interaction games theoretically at different points.

Knowledge representation: Agents update their beliefs about their own political effectiveness based on how successful their efforts are with other agents.

Goals: Each stakeholder has a preferred policy outcome that he or she is trying to achieve. Senturion assumes that agents are rational utility maximizers trying to achieve their desired political outcomes subject to being part of a winning coalition.

Language: Senturion uses the medium of political proposals, moving or shifting from one political position to another, based upon real or perceived political pressure to represent the language of agents' interactions.

The Senturion approach models the intuition behind each stakeholder's political calculus in political discussions by breaking down the process into subelements that can be modeled. Each element models a particular part of the decision process, and by combining the elements sequentially, the approach can anticipate how all stakeholders will interact to arrive at a particular decision or political outcome. The approach is a dynamic and recursive estimation of how stakeholders will interact and the resulting compromises and coalitions that will form in response. Table 4 lists Senturion's component theories and their various attributes.

Figure 4 provides an overview of Senturion. The initial stakeholder environment is defined as a policy issue of political interest; for example, the range of feasible levels

Table 4 Senturion theories and elements

Unit of analysis	Model type	Assumptions	Key variables
Individual decisionmaker	Microeconomics Individual decision making Rational choice Expected utility Spatial bargaining Median voter theorem Risk theory	Individual leader of society is a key stakeholder who can produce outcome Such actors maximize net gains in confrontations Risk is a variable connected to individual decision-makers Divergent preferences for competing goals held with varying degree of commitment are at the root of war Bounded rationality prevents decision-makers from maximizing expected utility	Stakeholder's position Potential power to I influence over the political outcome Salience of particular political issue relative to other concerns Group Importance Issue continuum

Structural environment	Core logic	Implication	Weaknesses
For commercial purposes, Sentia Group released Senturion, the integrated EU computational solution for political, economic, and business analysis	Senturion is a computational solution stakeholder analysis The stakeholder model embedded in Senturion is an agent-based model powered by expected utility equation basis Stakeholders' position, influence, salience data is required Based on those data, agent based stakeholder modeling is performed to predict bargaining outcomes	Senturion can provide a consistent framework for objective analysis of stakeholder politics, rather than relying solely on individual expert opinions about political outcomes	Reliance on experts to extract data regarding stakeholders' position, influence, and salience

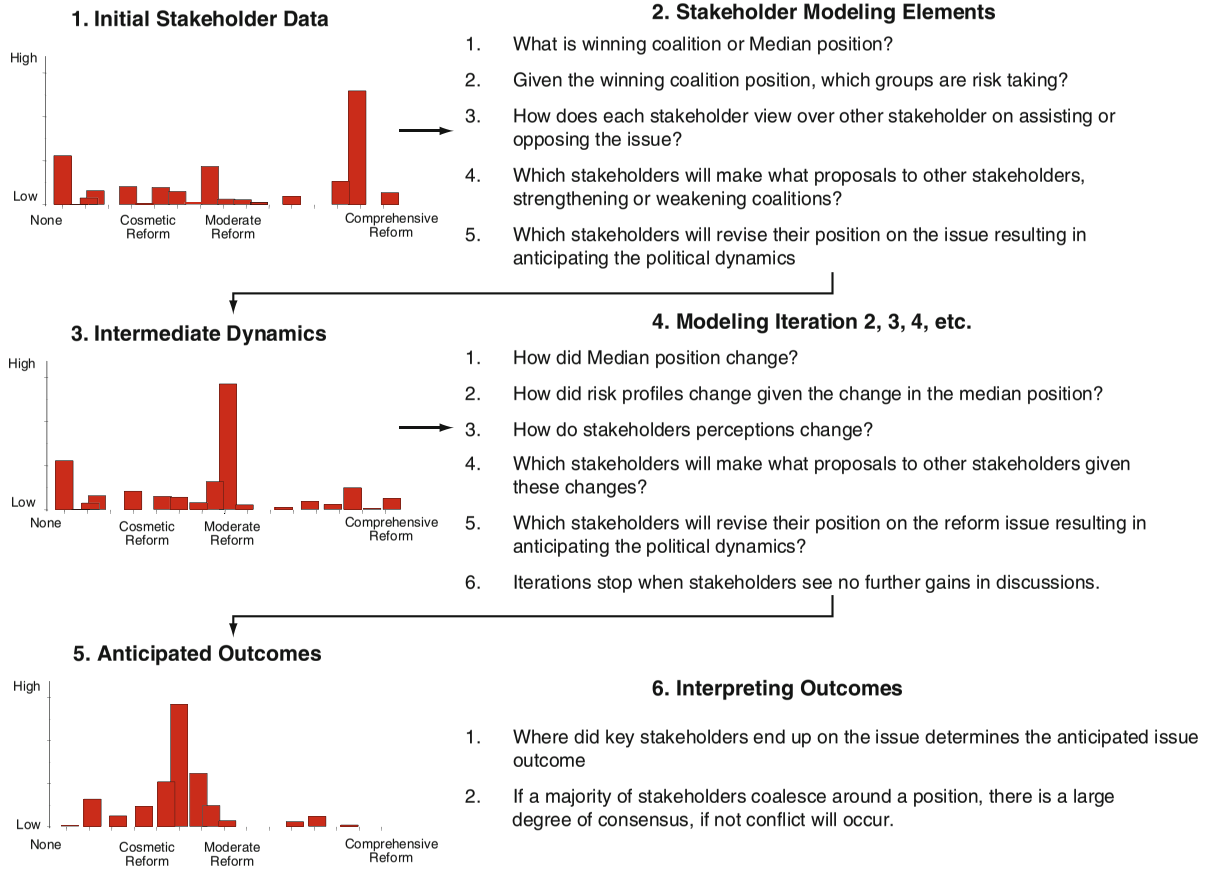

Fig. 4 Senturion process

of budgetary allocation in dollars that stakeholders will compete to influence. This is where individuals vie and compete to influence the ideas and actions of others to support their own claims and political positions. This one-dimensional environment is populated with agents that represent stakeholders that have a potential to influence the particular political issue. These can be individuals, political parties, governments, or members of society. Each of these stakeholders has different attributes, such as a preferred political outcome that locates them in the spatial context, as well as a separate potential to influence that outcome weighted by their salience on the particular issue. This creates a *snapshot* of the political landscape that is quite similar to polling data in American politics or consumer preferences in market surveys.

The second step is to apply micro rules and equations to the agents given their individual attributes, the knowledge and beliefs they form given that particular snapshot of the landscape to influence their social interactions to animate the landscape and ultimately their anticipated behavior. Thus, Senturion first starts with locating the political center of gravity, called the median from the spatial bargaining context. Intuitively, the political center outlines the place where compromise can most likely occur. If one knows what the winning compromise position will be, then we can begin to deduce several other key ideas.

Here, the median position is recognized as the safest position politically, while positions far from the median are more risky. If it is known which stakeholders are willing to take risks, they may be willing to take bigger gambles to get what they want or "hold out," while if they are not willing to take risks, they may be more willing to "sell out." This assumes that more extreme stakeholders are willing to take risks while stakeholders near the political center are willing to make deals in order to achieve an agreement.

Risk-taking propensities subsequently distort how stakeholders will view each other. With these distortions, Senturion estimates the pulling and hauling of the political process by a behavioral game tree. The game structure looks at the anticipated gains or losses of every pair of stakeholders on the particular issue, identifying where offers or compromises will be exchanged between two stakeholders. It then looks at the entire network of proposals among all stakeholders given the pairwise game-theoretical interactions in order to anticipate which stakeholders will revise their positions to produce the third step of iterative dynamics.

Given that stakeholders' positions may change, how has this changed the median? If the median has changed, how have risk profiles changed, with associated impact on perceptions, proposals, and resulting position shifts? Senturion iterates the process to simulate the evolution of political dynamics over time.

One benefit of this approach is that it provides a consistent framework for objective analysis of stakeholder perceptions rather than relying solely on individual expert opinions about political outcomes. Moreover, as with any simulation tool, the specific dynamics of stakeholder proposals surrounding particular political issues can be examined in order to first gauge whether outcomes are politically feasible, second to determine possible strategic options for optimizing political outcomes using knowledge about the stakeholder dynamics, and third to anticipate unintended consequences (second and higher order effects) of actions.

3.3.2 Defining the Political Landscape and Generating Data

The process starts with representing agents in a political state space as opposed to physical environments (Gilbert and Troitzsch 1999). Adopted from economics and positive political theory, Senturion draws from spatial analysis the unidimensional issue(s) that comprise a particular political or strategic problem (Luce and Raiffa 1957; Riker and Ordeshook 1968; Ordeshook 1986). Following Feder's (1994) and Stokman's (2000) processes in collective decision-making, Senturion decomposes any strategic decision problem into its requisite parts in order to define one or multiple issue spaces to populate with agents. Agents are then populated on the landscape with varying attributes given subject matter inputs as described below.

- Desired issue position
- Potential power or influence over the political outcome
- Salience or importance of particular political issue relative to other concerns.

As described above, issues are unidimensional ranges of political outcomes, such as support for a particular reform policy, levels of preferred taxation, or stability. Power is defined as an actor's capability to affect outcomes, position is each actor's desired issue outcome, while salience measures the importance or how much of the actor's agenda the issue occupies (Coplin and O'Leary 1972; Feder 1994; Bueno de Mesquita and Stokman 1994; Kugler and Feng 1997). Thus, stakeholders now have particular influence, importance and positional attributes that could be assigned and scaled to arrive at a relative ranking of political viability but not actual political outcomes. This

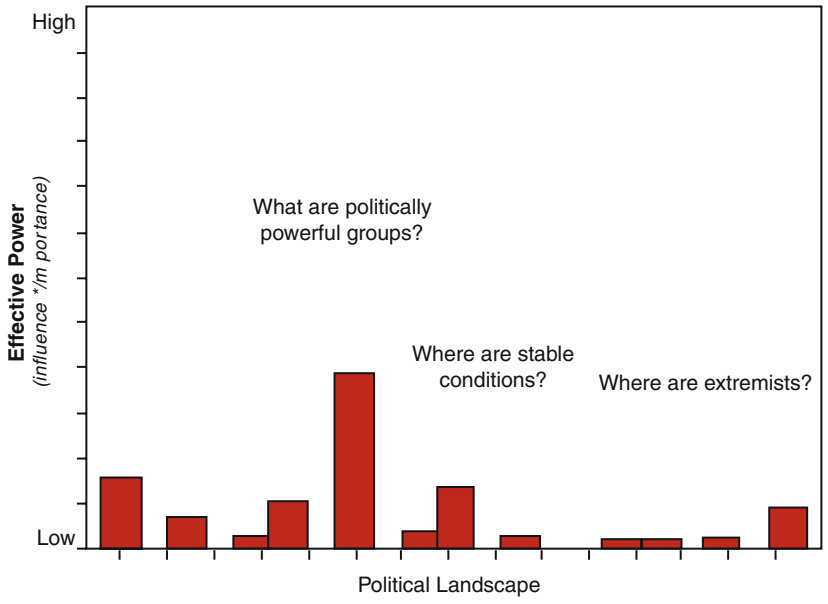

Fig. 5 Stakeholder data

"snapshot of the political landscape" (Fig. 5) shows stakeholders' initial attributes and is subsequently processed and animated by computational processes.

3.3.3 Overview of Senturion Algorithms

Given the generation of the stakeholder political landscape, the Senturion algorithm computes several key components used in various steps. It computes Votes and Forecast, Risk, and Power, expected utility values in a game tree, the resulting Perceptions, subsequent Proposals, Learning from interactions and finally a discount function to determine if agents will continue to interact. Figure 6 outlines the general algorithm and process.

Votes and Forecast capture the support that every stakeholder gets from every other stakeholder. These are used to compute the Median position that is the safest position politically. Stakeholder votes are simply computed by weighing each stakeholder's potential to influence multiplied by their particular salience or importance of the issue to the stakeholder. Thus, the Forecast is the most preferred

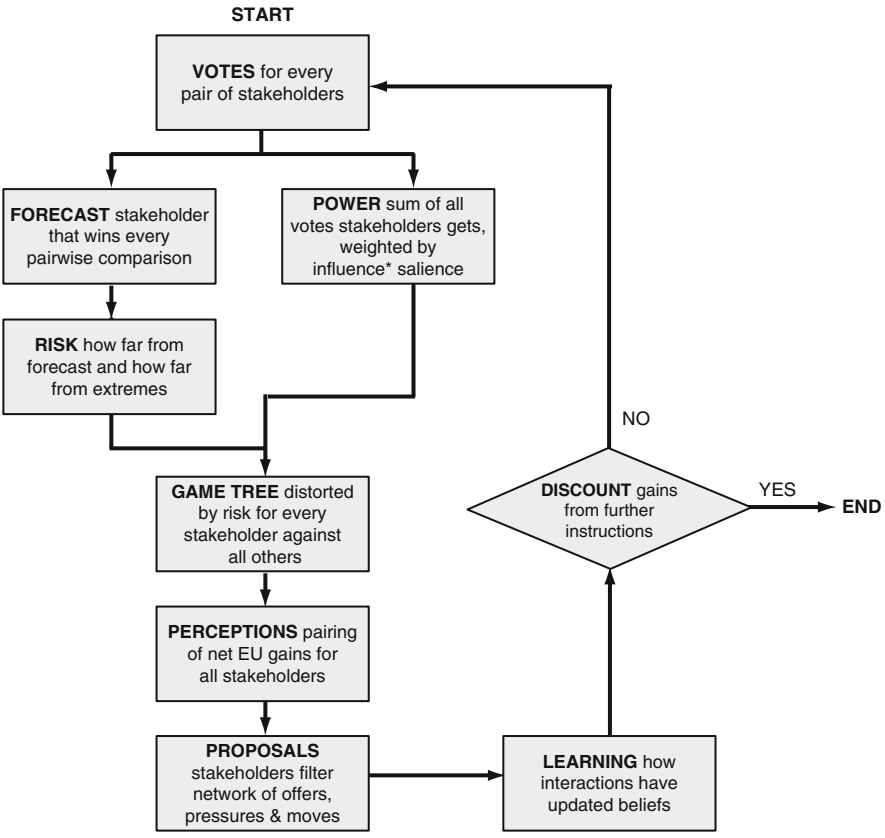

Fig. 6 Senturion algorithm

stakeholder position given all votes. Black (1948) originally proposed the median voter theorem, which identifies the median as the winning position on unidimensional continua among all other alternatives. Enelow and Hinich (1984), Bueno de Mesquita (1985), and Hinich and Munger (1997) suggest how to weight agents' votes in the context of policy applications.

Risk is a key concept that introduces distortions among stakeholder knowledge of the particular political landscape and allows for the incorporation of perceptions to help drive different political dynamics. Risk is computed for each agent to determine the perceptual prism through which the agent views other individuals and introduces distortions to the way individuals will interact. Simon (1955) outlines the evaluation of alternatives in terms of gains and losses relative to a reference point such as the status quo. Thus, risk-taking attitudes can be different above or below this point. Risk-taking propensity is assumed to be individually symmetric around losses and gains. If an agent is risk-acceptant on gains, he or she is also risk-acceptant on losses, maintaining the same risk tendency on either side. Newman (1982) shows how to calculate risk for multiple stakeholders. Thus, every agent balances his or her interests of obtaining policy satisfaction versus the security of being part of a winning coalition (Morrow 1986; Lamborn 1991). It then follows to connect risk propensities back to the status quo, or in this particular case, Black's weighted median for a particular distribution of the political landscape. Thus, stakeholders with positions farther from the median tend to be risk-acceptant while agents close to the median tend to be risk-averse.

Power measures the level of influence of each stakeholder given the likelihood of third-party support. Power is a dyadic value established by Singer et al. (1972) that introduces the notion of relative influence of stakeholders compared to all other stakeholders in a particular political process. Stoll and Ward (1989) explore this concept in detail with alternative measurements that produce effective relative measures of capabilities.

A generalized game tree of political interactions is specified and solved given the expected gains or losses for every pair of stakeholders from each stakeholder. Game theory allows us to specify the social model of political interactions among agents (Harsanyi 1968; Camerer 2003). Kadane and Larkey (1983) and Shubik (1983) show how actors choose to maximize utilities in a rational manner; a potential solution arises in decomposing a large n-person game with n-parallel two-person games. Senturion employs a generalized game that all stakeholders face in their interactions with all other stakeholders. Every agent interacts with every other agent and considers the possibility to challenge or not to challenge his or her opponent depending on the relative expected gains. When two agents decide not to challenge each other, the result is a stalemate. When two agents decide to challenge each other, the result is conflict. When one agent decides to challenge the other while his opponent does not want to challenge, then the result is a potential political offer that may or may not be accepted by the other stakeholder, as shown in Fig. 7.

Perceptions map out the net gains or losses in every dyad of agents, anticipating stakeholder interactions as peaceful, mutually conflictual, or in favor of one or the other. Based on the assumption that agents act according to their perceptions of a given political environment, each agent's perceptions are paired together to produce the anticipated

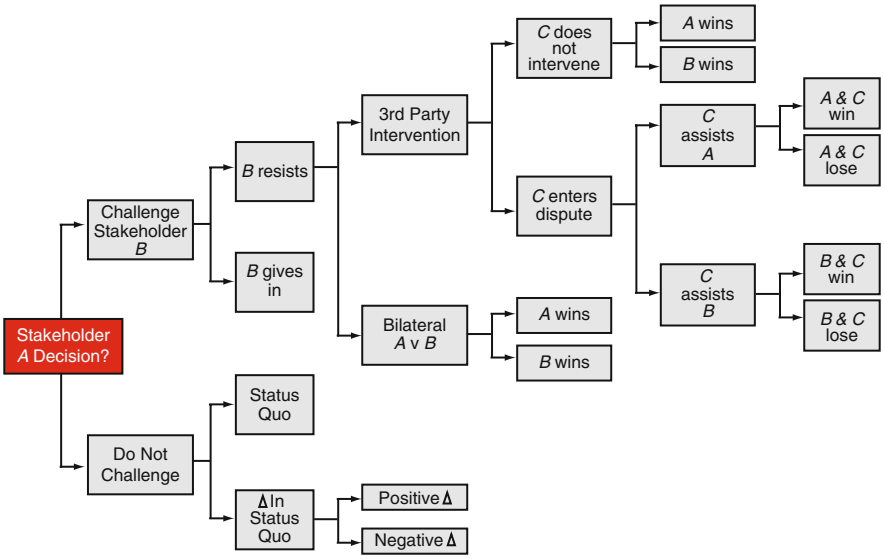

Fig. 7 Game tree

behavioral interaction between two stakeholders. Inspired by Jervis's (1978) work on misperceptions, both Lalman (1988) and Morrow (1986) define a continuous outcome approach to map behavioral interactions. Thus, different game-theoretical outcomes are translated into a perceptual mapping that identifies the behavior relations of every stakeholder versus every other stakeholder on a particular political issue.

Proposals translate the particular stakeholder perceptions back onto the specific policy landscape as offers, pressures, and moves to which stakeholders are subject. As stakeholders may have any combination of positive and negative net EU gains given our perceptual mappings, we must sort through the network of all behavioral relations to identify the push and pull of political dynamics. This is the kind of communication that takes place during agent interactions in an agent-based computational approach. Lalman (1988), Bueno de Mesquita and Stokman (1994), and Kugler and Feng (1997) outline various conditions for stakeholder interactions. An offer is made when a stakeholder believes that there is some positive gain to be made, although this offer may or may not be credible based upon differences in risk perceptions. An offer is made when the driver perceives himself as being able to secure some gains by imposing on or bargaining with the target. In the former case, the driver makes the target move all the way to his position. In the latter case, the driver makes the target move closer but not all the way.

Stakeholders may also learn or update their beliefs about the political landscape given their interaction with all other pairs of stakeholders. Given stakeholder dynamics, information is transmitted through proposals that may create learning among all stakeholders. Stakeholders subsequently can update their beliefs about the political landscape, such as which offers were successful, that can affect future proposals depending on various rules.

Finally, a discount function determines whether the process is iterated again depending on whether stakeholders see gains from further interactions. As stakeholder dynamics may cause some stakeholders to move, their positions on the issue continuum are changed, and thus Senturion animates the evolution of the political landscape through simulated time over several iterations. This process could iterate indefinitely, but that would not accurately mimic the dynamics of political processes, as rules for termination of ABMs vary widely depending on the specific application area. Intuitively, stakeholders will stop the political process when they see no further value from continued interactions (Laibson 1997).

3.3.4 Case Study: Iraq Elections, 2005

This section details the findings from a project focused on support for the January 2005 elections in Iraq, using only open-source data from SMEs from the intelligence community and the Washington Institute for Near East Policy (Abdollahian et al. 2006). Table 5 summarizes Senturion predictions based on data collected by the end of December 2004 and compares them to actual events that unfolded over the following 2 months.

Senturion predicted that a change of approach that made neutral Iraqis feel safer, by either coalition forces or the insurgency, would have allowed either the United States or insurgents to gain the support of neutral Iraqis. A major question facing analysts and decision-makers before the election was the role that other nations in the region might play, and how to assess the reactions to the election of major players in the international community. France, Russia, and Germany were expected to coalesce and increasingly support the election, but their impact would be minimal on Iraqi attitudes.

In assessing the insurgency in Iraq, Senturion provided two conclusions. Zarqawi and other foreign insurgents had very little leverage to undermine support for the election at this point. On the other hand, domestic insurgents, composed mainly of former regime elements, had most of the leverage in this situation in the months before the election. However, they did not recognize the extent of their potential influence. As with any simulation tool, this approach can also be used to test alternative political courses of action. The assumptions, policies, and tactics of U.S. stakeholders can be simulated to identify first- and second-order consequences and then adjusted to find the optimal approach to a particular situation. Moreover, because this approach calculates the perceptions of stakeholders, it can also identify circumstances when perceptions of key stakeholders are inaccurate. At times, such knowledge may form the basis for a plan of action to exploit such limits of perception.

To anticipate political reactions in advance of the 2005 elections, several courses of action to improve the situation were explored. First, a way to persuade Sunni tribal elements to moderate their opposition to the election was identified. Second, a way to obtain support from some former regime elements was sought. Finally, the implications of adjusting the force structures in Iraq were also explored by varying U.S. power levels. A reduced coalition military presence in Iraq would not have appreciably affected the attitudes of Iraqi stakeholders. However, increased coali-

Table 5 Senturion predictions compared to actual events

Predictions (based on 12/30/2004)	Actual events	Date of actual event
Insurgents will continue scope and pace of attacks	Repeated attacks by insurgents continued through the elections	1/31/2005
Strong supporters of the elections, particularly Sistani's followers and secular Shia, will participate in the election	Sistani's supporters and secular Shia voted in large numbers in the election	2/1/2005
Sadrists will be indecisive about supporting the election despite positive signs during January	Sadrists straddle both sides of the election issue, neither boycotting nor actively opposing the process	1/31/2005
Secular Sunnis and Sunni tribal elders will remain neutral toward the election	Sunnis disproportionately stayed home during the election, while not actively opposing the process	2/1/2005
Kurds will strongly support the election	Kurds turned out for the election in large numbers 1/31/2005	2/1/2005
Tension will remain high between Kurds and Shia	Tension between Kurds and Shia on future of Iraq appears to remain high despite the election	1/31/2005
Zaarqawi and foreign insurgents will have little success in undermining support for election in January	Election went forward with high Shia participation, despite attacks by insurgents	2/1/2005
World Bank and IMF will pull back support of the election	Timing and willingness of World Bank and IMF reconstruction efforts in Iraq unclear	1/28/2005
France, Russia, and Germany will increasingly support the election	France and Germany praise the Iraqi election. Russian response ambiguous	2/2/2005

tion military strength in Iraq would have improved the attitudes of Iraqi stakeholders toward the election in the short term, by making them feel more secure.

4 Practical Advice

- Begin modeling by determining the specific political issue, event, or risk in question. For instance: Is it the relations between two countries or a large bloc as a whole? Or, is it the emergence of insurgent groups in general or the effects that a particular group may have on domestic capital formation in a specific region? Recognize that there will always be political variables or phenomena that are outside the project's scope.
- Consider the purpose of the model in order to select the modeling approach. If the client faces an investment decision abroad and wishes to know the probability of an armed conflict in the region, an interstate or structural approach is applicable. If the concern is with the potential enactment of a specific policy that may affect the business, then an agent-based, micro-level approach may be more likely to succeed.

- Determine the desired tradeoff between the level of predictive accuracy and explanatory power. A simple, parsimonious model with a few theoretical building blocks may not be best for predictive accuracy, while an elaborate, complex model that combines multiple theoretical building blocks may increase predictive accuracy at the expense of explanatory power.
- Use Tables 1 and 2 in this chapter to select competing and complementary building blocks for the model. Competing blocks explain similar phenomena with different assumptions and are difficult to combine in the same model. Complementary blocks can be combined in parallel or in series.
- When building a model, construct a flowchart of the political or decision-making process of interest to help visualize and sequence the theoretical building blocks.
- When integrating and testing a model, beware of nonlinear subprocesses whose feedback can drive and overcome the output not only of the next building block but also of the entire system. Here, scaling of variables can be useful to dampen the potential impact across building blocks.

5 Summary

Political modeling generally falls into three categories: micro-level dynamics (the expected actions and interactions of individuals, groups, or governments), intranational structural dynamics (the subnational, structural factors that politically propel a nation, such as economic prosperity, democratization, or other national indicators), and international structural dynamics (the cross-national comparisons of national factors). Each of these categories is best assessed using a particular methodology, e.g., agent-based modeling, dynamic modeling, or game modeling. Our classification system helps assess the applicability of various political theories. It includes unit of analysis, model type, assumptions, key variables, structure of the environment, and the core logic of how the variables are related, in addition to the main implications, empirical support, and shortcomings of these theories. Macro interstate approaches include models that investigate the dynamics of political competition by using coupled differential equations, e.g., deterministic relationship between two states based on action and reaction, in which a small buildup by one side would lead to a larger counter by the opponent. An example of a macro intrastate approach is the POFED model, a dynamic general-equilibrium model based on the intersection of political and economic maximization function: individuals seek to maximize their lifetime utility by choosing how much to consume, while policymakers choose the tax rate and the amount of public investment and military spending to maximize their chances of remaining in power. Micro individual approaches focus on individual decisions of key political actors, leaders, and organizations, where models often use expected utility and must address the issue of risk. Senturion is an example that combines several micro-level theoretical blocks drawn from game theory, decision theory, spatial bargaining, and microeconomics. This simulation-based tool is used to predict political events, anticipate domestic or international political stability levels, and analyze specific investment decisions

where political matters affect outcomes. In one case study, Senturion analyzed the 2005 Iraqi elections, and correctly predicted that an increase in Coalition military forces would improve Iraqi attitudes toward the election.

6 Resources

1. Pointers to collections of data that can be used to initialize and validate political modeling of conflict and cooperation

   The Correlates of War Project (COW)
   Cross-National and Cross-Time Conflict Dataset Hosting Program
   http://www.correlatesofwar.org/

   The Groningen Growth and Development Center (GGDC)
   Economic Historical Statistics (Angus Maddison)
   http://www.ggdc.net/

   World Development Indicators (WDI)
   Economic Statistics including more than 800 indicators. (The World Bank)
   www.worldbank.org/data

   International Financial Statistics (IFS)
   International Statistics on All Aspects of International and Domestic Finance.
   (International Monetary Fund)
   http://www.imfstatistics.org/imf/

   Government Finance Statistics (GFS)
   Annual Finance Statistical Data on General Government and Its Subsectors.
   (International Monetary Fund)
   http://www.imfstatistics.org/imf/

   UN data
   Gateway to Statistical Information from Databases of the UN and Member States. (United Nations Statistics Division)
   http://data.un.org/

   EUGene
   Expected Utility Generation and Data Management Program (D. Scott Bennett and Allan C. Stam, III)
   http://eugenesoftware.org/

   Global Terrorism Database (GTD), University of Maryland
   Information on Terrorist Events around the World since 1970 (National Consortium for the Study of Terrorism and Responses to Terrorism, START)
   http://www.start.umd.edu/start/data/

   Polity IV Project
   Dataset on Political Regime Characteristics and Transitions, 1800–2008
   http://www.systemicpeace.org/polity/polity4.htm

   Center for the Study of Civil Wars, PRIO

Data on Armed Conflict:
http://www.prio.no/CSCW/Datasets/Armed-Conflict/

Geographical and Resource Datasets
http://www.prio.no/CSCW/Datasets/Geographical-and-Resource/

Economic and Socio-Demographic Data
http://www.prio.no/CSCW/Datasets/Economic-and-Socio-Demographic/

Data on Governance
http://www.prio.no/CSCW/Datasets/Governance/

Uppsala University
Uppsala Conflict Database Project (UCDP)
http://www.pcr.uu.se/gpdatabase/search.php

James Fearon and David Laitin, Stanford University
Ethnicity, Insurgency, and Civil War (replication data)
http://www.stanford.edu/~jfearon/data/apsr03repdata.zip

James Fearon, Stanford University
Ethnic and Cultural Diversity by Country
http://www.stanford.edu/~jfearon/data/egroupsrepdata.zip

The Minorities at Risk (MAR) Project, University of Maryland
Dataset on Conflicts of Politically-Active Communal Groups
http://www.cidcm.umd.edu/mar/data.asp

The Kansas Event Data System (KEDS) Project, University of Kansas
Political Event Data focusing on the Middle East, Balkans, and West Africa
http://web.ku.edu/~keds/index.html

2. Useful books, guides, handbooks, collections of instructional materials relevant to political modeling
Ronald Tammen et al., Power Transitions: Strategies for the twenty-first century
http://www.cqpress.com/product/Power-Transitions-Strategies.html

Manus Midlarsky, Handbook of War Studies I, II. The Interstate Dimension *III: The Intrastate Dimension*
http://www.press.umich.edu/titleDetailDesc.do?id=348477

Yi Feng, Democracy, Governance, and Economic Performance: Theory and Evidence
http://mitpress.mit.edu/catalog/item/default.asp?tid=9932&ttype=2

Marina Arbetman, J. Kugler, Political Capacity and Economic Behavior
http://www.amazon.com/Political-Capacity-Economic-Behavior-Interdependence/dp/0813333644

Stathis Kalyvas, Logic of Violence in Civil War
http://www.cambridge.org/us/catalogue/catalogue.asp?isbn=0521854091

P. Collier, Nicholas Sambanis, Understanding Civil Wars (v 1 + 2)
http://extop-workflow.worldbank.org/extop/ecommerce/catalog/product-detail?product_id=3995594&

Barbara Walter, Reputation and Civil War
http://www.cambridge.org/us/catalogue/catalogue.asp?isbn=9780521763523

Douglas Lemke, Regions of War and Peace
http://www.cambridge.org/us/catalogue/catalogue.asp?isbn=0521809851

Andrew Kydd, Trust and Mistrust in International Relations
http://press.princeton.edu/titles/8091.html

3. Professional or academic organizations, NGOs, and foundations that are relevant to the political modeling
American Political Science Association
http://www.apsanet.org

International Studies Association
http://isanet.ccit.arizona.edu/

Peace Science Society (International)
http://pss.la.psu.edu/

Inter-University Consortium for Political and Social Research (ICPSR), University of Michigan
http://www.icpsr.umich.edu/icpsrweb/ICPSR/

Military Operations Research Society (MORS)
http://www.mors.org/

Center for the Study of Civil Wars (CSCW), PRIO
http://www.prio.no/CSCW

The MacMilan Center, Program on Order, Conflict Violence (Yale University)
http://www.yale.edu/macmillan/ocvprogram/

Uppsala Conflict Data Program
http://www.pcr.uu.se/research/UCDP/

4. Pointers to journals, newsletters, and other periodic publications particularly relevant to political modeling
American Political Science Review
http://journals.cambridge.org/action/displayJournal?jid=PSR

American Journal of Political Science
http://www.ajps.org/

International Interactions
http://www.tandf.co.uk/journals/titles/03050629.asp

International Studies Quarterly
http://www.wiley.com/bw/journal.asp?ref= 0020-8833

Journal of Conflict Resolution
http://jcr.sagepub.com/

Journal of Peace Research
http://jpr.sagepub.com/

Conflict Management and Peace Science
http://cmp.sagepub.com/

5. Pointers to conferences and workshops that study political modeling
   International Studies Association Annual Meeting
   http://www.isanet.org/

   Peace Science Society (International) Annual Meeting
   http://pss.la.psu.edu/

   American Political Science Association Annual Meeting
   http://www.apsanet.org/

   Midwest Political Science Association Annual Meeting
   http://www.mpsanet.org/

References

Abdollahian, M. (1996) *In Search of Structure: The Nonlinear Dynamics of International Politics*. Ph.D. dissertation Claremont Graduate School.

Abdollahian, M. and Kang, K. (2008) In Search of Structure: The Nonlinear Dynamics of Power Transitions. *International Interactions*, 34(4), 333–357.

Abdollahian, M., Kugler, J., Baranick, M. (2006) *Senturion: Predictive Political Simulation Model* (2006) Defense and Technology Paper, 32, Center for Technology and National Security Policy, National Defense University.

Abdollahian, M. and Alsharabati, C. (2003) Modeling the Strategic Effects of Risk and Perceptions in Linkage Politics. *Rationality and Society*, Winter.

Abdollahian, M., Nicholson, B., Nickens, M. and Baranick M. (2009) A Formal Model of Stabilization and Reconstruction Operations. *Military Operations Research Journal*, 14(3), 250–281.

Allison, G. T. (1971) *Essence of Decision: Explaining the Cuban Missile Crisis*. Boston: Little Brown.

Aron, R. (1966) *Peace and War*. Princeton University Press.

Arbetman, M. and Kugler, J. (1997) *Political Capacity and Economic Behavior*. Boulder, CO: Westview.

Arbetman, M. and Johnson, K. (2008) Power Distribution and Oil in the Sudan: Will the Comprehensive Peace Agreement Turn the Oil Curse into a Blessing? *International Interactions*, 34(4), 382–401.

Axelrod, R. (1986) An Evolutionary Approach to Norms. *American Political Science Review*, 80(4), 1095–1111.

Axtell, R., Axelrod, R., Epstein, J. M. and Cohen. M. D. (1996) Aligning Simulation Models: A Case Study and Results. *Computational and Mathematical Organization Theory*, 1(2), 123–141.

Barnett, T. (2004) *The Pentagon's New Map*. New York: Putnam.

Battalio, R. C., Kagel, H. and Jiranyakul, K. (1990) Testing between Alternative Models of Choice under Uncertainly: Some Initial Results. *Journal of Risk and Uncertainty*, 3, 25–50.

Bennett, S. and Stam, A. (2000) A Cross-Validation of Bueno de Mesquita and Lalman's International Interaction Game. *British Journal of Political Science* 30, 541–561.

Benson, M. and Kugler, J. (1998) Power Parity, Democracy, and the Severity of Internal Violence. *Journal of Conflict Resolution*, 42(2), 196–209.

Black, D. (1948) On the Rationale of Group Decision-making. *Journal of Political Economy*, 56, 23–34.

Brinton, C. (1952) *The Anatomy of Revolution*. New York: Vintage.

Brodie, B. (1959) *Strategy in the Missile Age*. Princeton, Princeton University Press.

Brown, C. (1995) *Chaos and Catastrophe Theories*. Thousand Oaks, CA: Sage Publications.

Bueno de Mesquita, B. (1980) An Expected-Utility Theory of International Conflict. *American Political Science Review*, 74(4), 917–931.

Bueno de Mesquita, B. (1985) The War Trap Revisited: A Revised Expected Utility Model. *The American Political Science Review*, 79(1), 156–177.
Bueno de Mesquita, B. and Riker, W. (1982) Assessing the Merits of Selective Nuclear Proliferation. *Journal of Conflict Resolution,* 26(2), 283–306.
Bueno de Mesquita, B. and Lalman, D. (1992) *War and Reason: Domestic International Imperative*. New Haven: Yale University Press.
Bueno de Mesquita, B. and Stokman, F. N. (eds). (1994) *European Community Decision Making: Models, Applications, and Comparisons*. New Haven: Yale University Press.
Buhaug, H. and Gates, S. (2002) The Geography of Civil War. *Journal of Peace Research*, 39(4), 417–433.
Buhaug, H. and Lujala. P. (2004) *Terrain, Resources and Civil War — Does the Level of Measurement Matter?* Paper presented at the 45th Annual International Studies Association Convention, Montreal, Canada, March.
Cacey, J. T. (1994) Buyers' Pricing Behavior for Risky Alternatives, Encoding Processes and Preference Reversals. *Management Science*, 40, 730–749.
Camerer, C. F. (2003) *Behavioral Game Theory*. Princeton: Princeton University Press.
Camerer, C. F. and Lowenstein, G. (2003) Behavioral Economics: Past, Present, Future. In C. F. Camerer, G. Lowenstein and M. Rabin (eds). *Advances in Behavioral Economics*. Princeton: Princeton University Press.
Cavusoglu, N. and Tebaldi, E. (2006) Evaluating Growth Theories and their Empirical Support: An Assessment of the Convergence Hypothesis. *Journal of Economic Methodology*, 13(1), 49–75.
Cederman, L. E. (2004) *Articulating the Geo-Cultural Logic of Nationalist Insurgency*. Workshop on Origins and Patterns of Political Violence I: Violence in Civil Wars, Santa Fe Institute, January.
Collier, P. and Hoeffler, A. (1998) On Economic Causes of Civil War. *Oxford Economic Papers*, 50, 563–573.
Collier, P. and Hoeffler, A. (2002) On the Incidence of Civil War in Africa. *Journal of Conflict Resolution*, 46(1), 13–28.
Collier, P. and Hoeffler, A. (2004) Greed and Grievance in Civil War. *Oxford Economic Papers*, 56, 563–595.
Coplin, W. D. and O'Leary, M. K. (1972) *Everyman's Prince: A Guide to Understanding Your Political Problems*. North Scituate, MA: Duxbury Press.
Crenshaw, M. (1995) Democracy and Demographic Inheritance: The Influence of Modernity and Proto-Modernity on Political and Civil Rights, 1965 to 1980. *American Sociological Review*, 60, 702–718.
Davies, J. C. (1962) Toward a Theory of Revolution. *The American Sociological Review*, 27, 5–13.
Diamond, L. (1992) The Globalization of Democrarcy. In R. Slater (ed).*Global Transformation and the Third World*. Boulder, CO: L. Rienner Publishers.
Downs, A. (1957) *An Economic Theory of Democracy*. New York: Harper.
Doran, C. F. (2003) Economics, Philosophy of History, and the Single Dynamic of Power Cycle Theory: Expectations, Competition, and Statecraft. *International Political Science Review*, 24(1), 13–49.
Earman, J. (1992) *Bayes or Bust? A Critical Examination of Bayesian Confirmation Theory*. Cambridge: MIT Press.
Edwards, K. D. (1996) Prospect Theory: A Literature Review. *International Review of Financial Analysis*, 5, 18–38.
Elbadawi, I. and Sambanis, N. (2002) How Much War Will We See? Explaining the Prevalence of Civil War. *Journal of Conflict Resolution*, 46(3), 307–334.
Enelow, J. and Hinich, M. (1984) A *Spatial Theory of Voting*. Cambridge: Cambridge University Press.
Engerman, S. and Sokoloff, K. (2002) Factor Endowments, Inequality, and Paths of Development Among New World Economies. *NBER Working Paper No. 9529*.
Fearon, J. D. (1994) Signaling versus the Balance of Power and Interests: An Empirical Test of a Crisis Bargaining Model. *Journal of Conflict Resolution*, 38, 236–269.

Fearon, J. D. (2004) Why Do Some Civil Wars Last So Much Longer Than Others? *Journal of Peace Research*, 41(3), 275–302.
Fearon, J. D. and Laitin. D. D. (2003) Ethnicity, Insurgency, and Civil War. *American Political Science Review*, 97(1), 75–90.
Fearon, J. D. and Laitin, D. D. (2002) Selection Effects and Deterrence. *International Interactions*, 28(1), 5–29.
Feder, Stanley (1994) Declassified Factions and Policon: New Ways to Analyze Politics. *Studies in Intelligence*, Central Intelligence Agency.
Feng, Y., Kugler, J. and Zak, P. (2000) The Politics of Fertility and Economic Development. *International Studies Quarterly*, 44(2), 667–693.
Feng, Y., Kugler, J., Swaminathan, S. and Zak, P. (2008) Path to Prosperity: The Dynamics of Freedom and Economic Development. *International Interactions*, 34(4), 423–441.
Friedman, M. and Savage, L. (1948) Utility Analysis of Choices Involving Risk. *Journal of Political Economy*, 56(4), 279–304.
Guevara, C. (1968) *Guerrilla Warfare*. New York, NY: Monthly Review Press.
Gilbert, N. and Troitzsch, K. G. (1999) *Simulation for the Social Scientist*. New York: Open University Press.
Gilpin, R. (1981) *War and Change in World Politics*. UK: Cambridge University Press.
George, A. L. and Smoke, R. (1989) Deterrence and Foreign Policy. *World Politics*, 41(2), 170–182.
Goldstein, J. (1988) *Long Cycles: Prosperity and War in the Modern Age*. New Haven: Yale University Press.
Grossman, H. (1991) A General Equilibrium Model of Insurrections. *American Economic Review*, 81, 912–921.
Guillaumont, P. and Jeanneney, S. (1999) How Instability Lowers African Growth. *Journal of African Economies*, 8, 87–107.
Gurr, T. R. (1974) Persistence and Change in Political Systems, 1800–1971. *American Political Science Review*, 68(4), 1482–1504.
Harsanyi, J. C. (1968) Games with Incomplete Information Played by 'Bayesian' Players. Part III: Basic Probability Distribution of the Game. *Management Science*, 14(7), 486–502.
Hegre, H. and Sambanis, N. (2004) *Sensitivity Analysis of the Empirical Literature on Civil War Onset*. Paper presented at the General Meeting of the European Union Polarization and Conflict Project, Oslo, Norway, July.
Hendrix, C. and Glaser, S. (2007) Trends and Triggers: Climate, Climate Change and Civil Conflict in Sub-Saharan Africa. *Political Geography*, 26(6), 695–715.
Hinich, M. and Munger, M. (1997) *Analytical Politics*. Cambridge: Cambridge University Press.
Humphreys, M. (2005) Natural Resources, Conflict and Conflict Resolution. *Journal of Conflict Resolution*, 49(4), 508–537.
Huntington, S. (1968) *Political Order in Changing Societies*. New Haven: Yale University Press.
Huth, P. and Russett, B. (1990) Testing Deterrence Theory: Rigor Makes a Difference. *World Politics*, 42(4), 466–501.
Inglehart, R. (1997) *Modernization and Postmodernization*. Princeton: Princeton University Press.
Intriligator, M. and Brito, D. (1976) Formal Models of Arms Race. *Journal of Peace Science*, 2, 77–88.
Intriligator, M. and Brito, D. (1981) Nuclear Proliferation and the Probability of War. *Public Choice*, 17, 247–260.
Intriligator, M. and Brito, D. (1984) Can Arms Races Lead to the Outbreak of War? *Journal of Conflict Resolution*, 28, 63–84.
Jervis, R. (1978) Cooperation under the Security Dilemma. *World Politics*, 40(1), 167–214.
Jones, C. (1995) Time Series Tests of Endogenous Growth Models. *The Quarterly Journal of Economics*, 110(2), 495–525.
Kadane, J. B. and Larkey, P. D. (1983) The Confusion of Is and Ought in Game Theoretic Contexts. *Management Science*, 29(12), 1365–1379.
Kadera, K. (1995) The Conditions and Consequences of Dyadic Power Transitions: Deductions from a Dynamic Model, In J. Kugler and D. Lemke (eds). *Parity and War: A Critical Evaluation of the War Ledger*. Ann Arbor: The University of Michigan Press.

Kahneman, D. and Tversky, A. (1979) Prospect Theory: An Analysis of Decision under Risk. *Econometrica*, 47(2), 263–292.
Kleindorfer, P. R. and Kunreuther, H. (1982) Misinformation and Equilibrium in Insurance Markets. In Jörg Finsinger (ed). *Issues in Pricing and Regulation*. Lexington: Lexington Books.
Kim, W. and Morrow, J. D. (1992) When Do Power Shifts Lead to War? *American Journal of Political Science*, 36(4), 896–922.
Kim, W. (1996) Power Parity, Alliance, and War from 1648–1975. In Jacek Kugler and Douglas Lemke (eds). *Parity and War*. Ann Arbor: University of Michigan Press.
Knight, F. H. (1921) *Risk, Uncertainty and Profit*. Boston, MA: Houghton Mifflin.
Kugler J., Abdollahian M. and Arbetman M. (2005) *Identifying Fragile States*. DARPA PCAS Sentia Group, Inc. Washington DC.
Kugler J. and Lemke, D. (eds). (1996) *Parity and War*. University of Michigan Press.
Kugler, J. and Feng, Y. (eds). (1997) The Expected Utility Approach to Policy Decision Making. *International Interactions*, 23(3–4), 233–274.
Kugler, J. and Tammen, R. (eds). (2010) *Political Performance of Governments*. Forthcoming.
Kugler, J. and Zagare, F. C. (1987) Risk, Deterrence, and War. In J. Kugler and F. C. Zagare (eds). *Exploring the Stability of Deterrence*. Boulder: Lynne Rienner.
Laibson, D. (1997) Golden Eggs and Hyperbolic Discounting. *Quarterly Journal of Economics*, 112(2), 443–477.
Lalman, D. (1988) Conflict Resolution and Peace. *American Journal of Political Science*, 32(3), 590–615.
Lalman, D. and Bueno de Mesquita, B. (1989) The Road to War is Strewn with Peaceful Intentions. In Peter Ordeshook (ed). *Models of Strategic Choice in Politics*. Ann Arbor: University of Michigan Press
Lamborn, A. C. (1991) *The Price of Power: Risk and Foreign Policy in Britain, France, and Germany*. Boston: Unwin Hyman.
Lemke, D. and Reed, W. (1996) Regime Types and Status Quo Evaluations. *International Interactions*, 22(2), 143–164.
Lemke, D. and Werner, S. (1996) Power Parity, Commitment to Change, and War. *International Studies Quarterly*, 40 (2): 235–260.
Lemke, D. (2002) *Regions of War and Peace*. New York: Cambridge Univ. Press.
Lemke, D. (2010) Power Politics and the Violent Creation of Order. *American Journal of Political Science* (forthcoming)
Levy, H. and Levy, M. (2002) Experimental Test of the Prospect Theory Value Function. *Organizational Behavior and Human Decision Process*, 89, 1085–1081.
Levy, J and Thompson, W. (2010) *Causes of War*. Malden, Mass: Wiley-Blackwell.
Luce, R. D and Raiffa, H. (1957) *Games and Decisions: Introduction and Critical Survey*. New York: Wiley.
Mearsheimer, J. (2001) *The Tragedy of Great Power Politics*. New York: Norton.
Midlarsky, M. (ed). (2000) *Handbook of War Studies II*. Ann Arbor: The University of Michigan Press.
Midlarsky, M. (ed). (2009) *Handbook of War Studies III*. Ann Arbor: The University of Michigan Press.
Morrow, J. D. (1986) A Spatial Model of International Conflict. *American Political Science Review*, 80(4), 1131–1150.
Morrow, J. D. (1987) On the Theoretical Basis of a Measure of National Risk Attitudes. *International Studies Quarterly*, 31(4), 423–438.
Muncaster, R. and Zinnes, D. (1988) The War Propensity of International Systems. *Synthese*, 76(2), 307–331.
Nicholson, M. (1998) *Formal Theories in International Relations*, Cambridge Studies in International Relations v. 3. Cambridge University Press.
O'Neill, T. (1993) *All Politics is Local and Other Rules of the Game*. Hollbrook MA: Random House.
Ordeshook, P. (1986) *Game Theory and Political Theory*. Cabmridge: Cambridge University Press.

Organski, A. F. K. (1958) *World Politics*. New York: Alfred Knopf.
Organski A. F. K. and Kugler J. (1980) *The War Ledger*. Chicago, IL: University of Chicago Press.
Poggi, G. (1990) *The State: Its Nature, Development and Prospects*. Palo Alto, CA: Stanford University Press.
Powell, R. (1987) Crisis Bargaining, Escalation, and MAD. *American Political Science Review*, 81, 717–735.
Pratt, J. (1964) Risk Aversion in the Small and in the Large. *Econometrica*, 32, 122–136.
Raleigh, C. (2004) *Political Geography of Civil War: Patterns of Insurgency in Central Africa, 1960–2005*. Ph.D. diss., University of Colorado.
Rapoport, A. (1957) Lewis F. Richardson's Mathematical Theory of War. *Journal of Conflict Resolution*, 1(3), 249–292.
Rasler, K. and Thompson, W. (1994) *The Great Powers and Global Struggle, 1490–1990*. Lexington: University of Kentucky Press.
Richardson, L. F. (1960) *Arms and Insecurity*. Chicago: Quadrangle Books.
Riker, W. and Ordeshook, P. (1968) A Theory of the Calculus of Voting. *American Political Science Review*, 62(1), 25–42.
Rosenau, J. (1964) *International Aspects of Civil Strife*. Princeton, NJ: Princeton University Press.
Salehyan, I. and Gleditsch, K. (2004) *Refugee Flows and the Spread of Civil War*. Paper presented at the annual meeting of the American Political Science Association, Hilton Chicago and the Palmer House Hilton, Chicago, IL, Sep 02, 2004.
Saperstein, A. (1994) Chaos As A Tool For Exploring Questions of International Security. *Conflict Management and Peace Science*, 13(2), 149–177.
Schelling, T. (1960) *The Strategy of Conflict*. Cambridge: Harvard University Press.
Shubik, M. (1983) Comment on The Confusion of Is and Ought in Game Theoretic Contexts. *Management Science*, 29(12), 1380–1383.
Simon, H. (1955) A Behavioral Model of Rational Choice. *Quarterly Journal of Economics*, 69(1), 99–118.
Singer J. D., Bremer, S., Stuckey, J. (1972) Capability Distribution, Uncertainty, and Major Power War, 1820–1965. In B. Russett (ed). *Peace, War, and Numbers*. London: Sage Publications, pp. 19–48.
Small, M. and Singer, J. D. (1982) *Resort to Arms: International and Civil Wars, 1816–1980*. Beverly Hills, CA: Sage Publications.
Smoker, P. (1964) Fear in the Arms Race: A Mathematical Study. *Journal of Peace Research*, 1(1), 55–64.
Sokoloff, K. L. and Engerman, S. L. (1994) *Factor Endowments: Institutions, and Differential Paths of Growth Among New World Economies: A View from Economic Historians of the United States*. NBER Working Paper h0066.
Stoll, R. J. and Ward, M. D. (eds). (1989) *Power in World Politics*. Boulder: Lynne Rienner.
Tanter, R. (1966) Dimensions of conflict behavior with and between nations, 1958–60, *Journal of Conflict Resolution*, 10, 41–64.
Tammen, R., Kugler, J., Abdollahian, M., Alsharabati, C., Efird, B., Stam, A. and Organski, A. F. K. (2000) *Power Transitions: Strategies for the 21st Century*. New York: Chatham House.
Tilly, C. (1975) Reflections on the History of European State-Making. In Charles Tilly, Gabriel Ardant (eds). *The Formation of National States in Western Europe*, Princeton: Princeton University Press.
Von Neumann, J. and Mongerstern, H. (1944) *Theory of Games and Economic Behavior*. Princeton University Press.
Wagner, H. (1991) Nuclear Deterrence, Counterforce Strategies, and the Incentive to Strike First. *American Political Science Review*, 85(3), 727–749.
Waltz, K. (1979) *Theory of International Politics*. Massachusetts: Addison Wesley Publications.
Waltz, K. and Sagan, S. (1995) *The Spread of Nuclear Weapons: A Debate*. New York: W.W. Norton.

Welzel, R., et al. (2003) The Theory of Human Development: A Cross-Cultural Analysis. *European Journal of Political Research*, 42 (3), 341–380.
Zagare, F. and Kilgour, M. (2000) *Perfect Deterrence*. New York: Cambridge University Press.
Zagare, F. (2004) Reconciling Rationality with Deterrence: A Re-Examination of the Logical Foundations of Deterrence Theory. *Journal of Theoretical Politics*, 16(2), 107–141.
Zinnes, D. and Gillespie, J. (1976) *Mathematical Models in International Relations*. New York: Praeger Publishers, pp. 179–217.