FREDERICK S. PARDEE CENTER
FOR INTERNATIONAL FUTURES
EXPLORE UNDERSTAND SHAPE

WORKING PAPER 2014.03.05.a

IFs GOVERNANCE AND SOCIO-CULTURAL MODEL DOCUMENTATION

Authors: Barry B. Hughes and José R. Solórzano
March 2014

Note: If cited or quoted, please indicate working paper status.

UNIVERSITY of DENVER
JOSEF KORBEL SCHOOL OF INTERNATIONAL STUDIES PARDEE.DU.EDU

IFs Governance and Socio-Cultural Model Documentation

Table of Contents

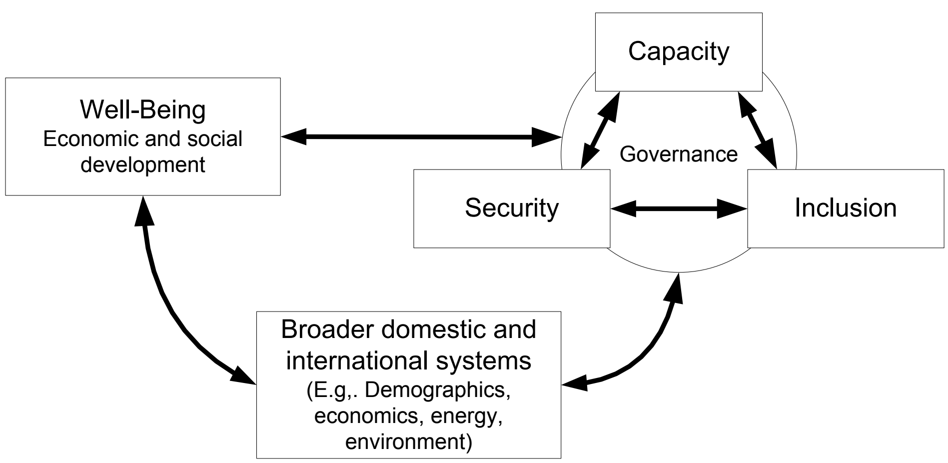
1. Introduction

1.1 Overview

Governance is the two-way interaction between government and the broader socio-political or, even more broadly, socio-cultural system. Although our documentation and the IFs model itself focuses primarily on three dimensions of that governance interaction, we will need also to direct some attention specifically to that broader socio-cultural system and how it might change over time.

The conceptual foundation for the representation of governance in IFs owes much to an analysis of the evolution of governance in countries around the world over several centuries. That analysis (see Chapter 1 of the *Strengthening Governance Globally* volume by Hughes et al. 2014) identified three dimensions of governance: security, capacity, and inclusion. It traced them over time and noted their largely sequential unfolding for currently developed countries and their currently simultaneous progression in many lower-income countries.

The three dimensions interact closely and bi-directionally with each other. They also interact bi-directionally with broader human development systems. The level of well-being, often captured quantitatively by GDP per capita or the more inclusive human development index, may be especially important, but is hardly alone in helping drive forward advance in governance; for instance, the age structures of populations and economic structures also interact with governance patterns both indirectly through well-being and directly.



The conceptualization of governance further divides each of the three primary dimensions into two sub-dimensions partly based on the desire to quantify them historically and to facilitate forecasting. For security those are the probability of intrastate conflict and the general level of country performance and risk. The two sub-dimensions of capacity are the ability to raise revenue and the effective use of it and the other tools of government—that is, the competence or quality of governance. We use corruption (that is, control of it) as a proxy for such competence. The first sub-dimension of inclusion is the level of formal democratization, typically assessed in terms of competitive elections. More broadly democratization involves inclusion of population groupings across lines such as ethnicity, religion, sex, and age; we use gender equity as a proxy for the second dimension.

See Hughes et al. (2014), especially Chapter 4, for more background on the development of the governance representations of IFs than this documentation provides. See also Hughes (2002) for earlier and/or complementary work in IFs on socio-political representations (domestic and international); for example, here we do not discuss the formulations for power, interstate threat, and conflict, but that is available in documentation on the International Political model of the IFs system. Finally, we not provide here the important information about the forward linkages of governance to other elements of IFs, including to the production function of the economic model and to the broader financial flows of the social accounting matrix representation. See documentation on the economic model for that information.

1.2 Dominant Relations

The drivers of change on each dimension and sub-dimension of governance range widely. A quick summary (see also the table below) is that:

- Probability of intrastate conflict is a function of past conflict, neighborhood effects, economic growth rate (inverse), trade openness (inverse), youth bulge, infant mortality, democracy (inverted-U), state repression (inverse), and external intervention.
- Vulnerability to intrastate conflict is a function of past intrastate conflict, energy trade dependence (as a proxy for broader natural resource dependence), economic growth rate (inverse), youth bulge, urbanization rate, poverty level, infant mortality, life expectancy (inverse) undernutrition, HIV prevalence, primary net enrollment (inverse), adult education levels (inverse), corruption, democracy (inverse), gender empowerment (inverse), governance effectiveness (inverse), freedom (inverse), inequality, and water stress.
- Government revenues are a function of past revenue as percentage of GDP, GDP per capita, and social expenditures (that is, inversely to fiscal balance).
- Corruption is a function of past corruption level, GDP per capita (inverse), energy trade dependence, democracy (inverse), gender empowerment (inverse), and probability of intrastate conflict.
- Democracy is a function of past democracy level, youth bulge (inverse), and gender empowerment; although normally disabled in the model, neighborhood effects and global leadership can also affect democracy level.
- Gender empowerment is a function of past gender empowerment level, GDP per capita, youth bulge (inverse), and adult educational attainment.

	Driven variables (May also be in driver category)					
	Security		Capacity		Inclusion	
Drivers	Internal War	Vuln to Conflict	Revenues	Corruption	Democracy	Gender Empowerment
Path Dependency (incl Culture)	Direct	Direct	Direct	Direct	Direct	Direct
External Environment						
Neighborhood effects	Direct				Direct	
Global leadership					Direct	
Foreign Aid						
Energy trade dependence		Direct		Direct	Inverse	
External intervention	Direct					
Economy						
Size per capita			Direct	Inverse		Direct
Growth rate (Moving average)	Inverse	Inverse				
Trade openness	Inverse					
Demography						
Youth bulge	Direct	Direct			Inverse	Inverse
Urbanization rate		Direct				
Human Development						
Poverty level		Direct				
Infant mortaltiy	Direct	Direct				
Life expectancy		Inverse				
Undernutrition		Direct				
HIV prevalence		Direct				
Primary net enrollment		Inverse				
Education of adults		Inverse				Direct
Security						
Internal war		Direct				
Vulnerability to conflict						
Capacity						
Revenues						
Corruption		Direct				
Inclusion						
Democracy	Inverted-U	Inverse		Inverse		
Gender empowerment		Inverse		Inverse	Direct	
Other sociopolitical						
Repression	Inverse					
Governance effectiveness		Inverse				
Freedom		Inverse				
Inequality		Direct				
Social expenditures			Direct			
Environmental						
Water stress		Direct				

There are some general insights with respect to elaboration of the formulations (equations and algorithms) that drive change on each dimension and sub-dimension of governance:

- In almost each case there are path dependencies that supplement the basic relationships—social change has considerable inertia.
- The driving and driven variables clearly constitute a complex syndrome of mutually interdependent developmental interactions, not a simple causal sequence.
- There is a tendency for the dimensions of governance traditionally developing later to feed back to earlier ones, notably for inclusion to affect capacity via reduced corruption and also for inclusion and capacity to reduce the probability of internal conflict.
- Behaviorally, the bi-directional structures suggest the possibility that reinforcing processes may accelerate as governance strengthens, setting up a kind of tipping from one equilibrium to another; vicious cycles of deterioration would also be possible.

For detailed discussion of the model's causal dynamics, see the discussions of flow charts (block diagrams) and equations.

1.3 Structure and Agent Based System: Governance

Structure and Agent System: Governance	
System/Sub System	Governance
Organizing Structure	Three dimensions with two sub-dimensions each; highly interactive, bi-directional relationships among dimensions and with socio-economic development, demographics, and economics
Stocks	Socio-economic development levels (e.g. level of education, gender relationships, size of the economy); past patterns of governance; also cultural patterns are a stock
Flows	Government spending on human capital, infrastructure, development generally; accretion of changes in governance over time
Key Aggregate Relationships	Probability of intrastate conflict is a function of past conflict, neighborhood effects, economic growth rate (inverse), trade openness (inverse), youth bulge, infant mortality, democracy (inverted-U), state repression (inverse), and external intervention. Vulnerability to intrastate conflict is a function of past intrastate conflict, energy trade dependence (as a proxy for broader natural resource dependence), economic growth rate (inverse), youth bulge, urbanization rate, poverty level, infant mortality, life expectancy (inverse) undernutrition, HIV prevalence, primary net enrollment (inverse), adult education levels (inverse), corruption, democracy (inverse), gender empowerment (inverse), governance effectiveness (inverse), freedom (inverse), inequality, and water stress Government revenues are a function of past revenue as percentage of GDP, GDP per capita, and social expenditures (that is, inversely to fiscal balance). Corruption is a function of past corruption level, GDP per capita (inverse), energy

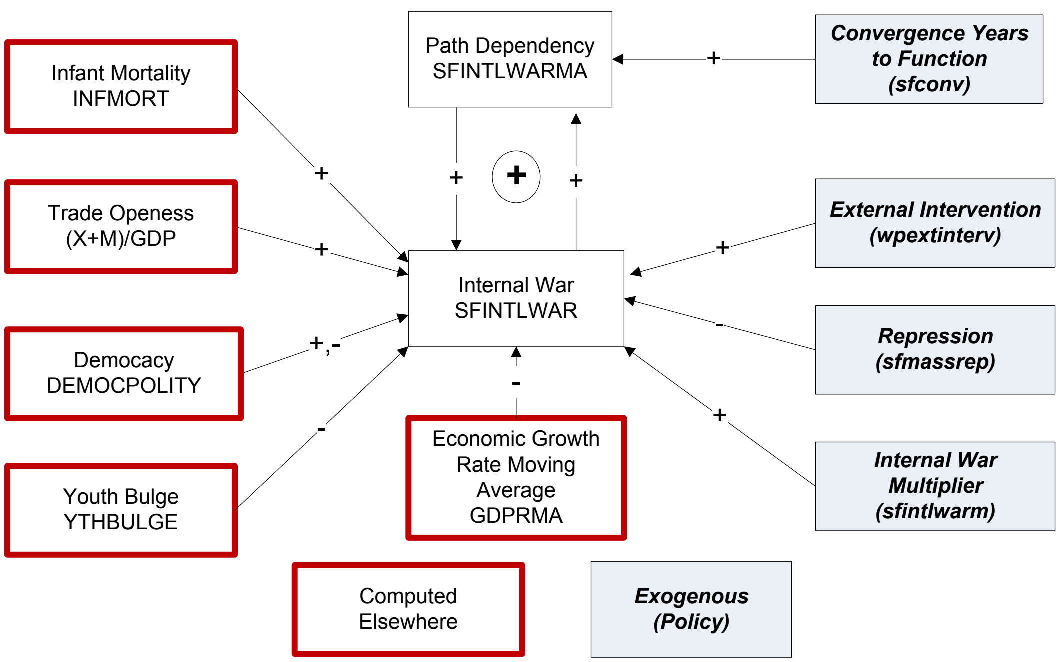
	trade dependence, democracy (inverse), gender empowerment (inverse), and probability of intrastate conflict. Democracy is a function of past democracy level, youth bulge (inverse), and gender empowerment. Gender empowerment is a function of past gender empowerment level, GDP per capita, youth bulge (inverse), and primary net enrollment.
Key Agent-Class Behavior Relationships	Social sub-group relationships, especially historical conflict patterns and gender relationships; government revenue and expenditure

2. Governance Flow Charts

We can show and briefly describe a block diagram for each of the three dimensions of governance and the two sub-dimensions of those: security (probability of intrastate or internal war and risk of conflict); capacity (ability to mobilize revenues and the effectiveness of their use); inclusiveness (formal democracy and broader inclusiveness, using gender empowerment as a proxy).

2.1 Security: Internal War

Internal or intrastate war (SFINTLWAR) is heavily determined by a moving average of a society's past experience with such conflict (SFINTLWARMA) in what is a positive feedback system. The probability of such conflict will, however, typically converge to that determined by more basic underlying drivers, and the user can control the speed of such convergence by specifying the years to convergence (***sfconv***).



The major driving variables in a statistical estimation are the level of infant mortality (INFMORT) as a proxy for quality of government performance and trade openness or exports (X) plus imports (M) as a share of GDP. In addition democracy level (DEMOCPOLITY) enters in a non-linear and algorithmic fashion, as do youth bulge (YTHBULGE) and a moving average of economic growth rate (GDPRMA).

Although less often used and turned off in the Base Case scenario, external interventions (***wpextinterv***) and mass repression (***sfmassrep***) can cause or at least temporarily dampen internal war, respectively.

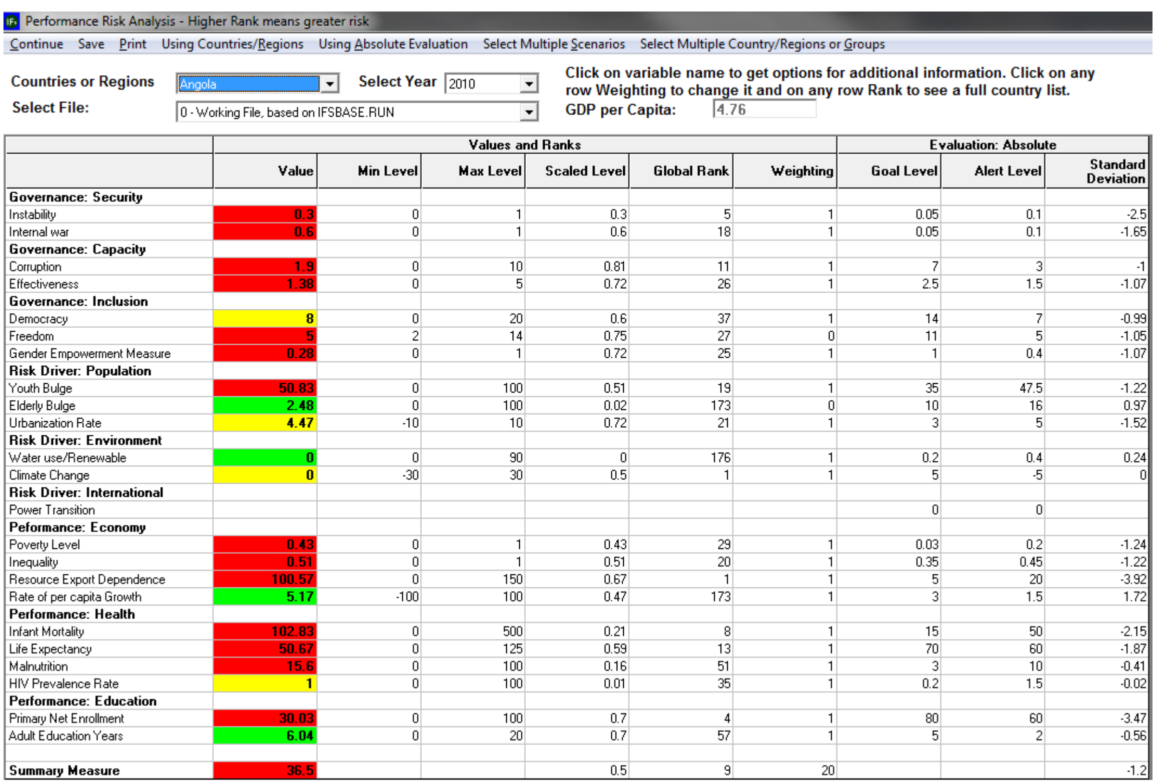
Finally, the user can multiply resultant endogenous values of internal war (***sfintlwarm***) in order to generate user-controlled scenarios.

The IFs system also includes a representation of instability short of internal war (**SFINSTABALL** and **SFINSTABMAG**), linking them to the category of abrupt regime change in the classification developed by Ted Robert Gurr and used by the Political Instability Task Force. The forecasting representation was developed before the revision and update of that for internal war, however, and we recommend less attention to it until its own revision is done.

2.2 Security: Vulnerability and Risk of Conflict

The IFs treatment of societal/governance performance risk and related vulnerability to conflict does not involve an estimated formulation. Instead, like other such efforts, it involves the creation of an index. The figure below, a screen capture of the form (reached via Specialized Displays) uses variables related both directly to governance and to performance. A specialized Help topic on this form is available.

Although many users will be interested in the rankings of countries (see the Global Rank column for ranks on individual variables and the summary measure for overall, variable-weighted rank), others will be interested in the summary value across all variables, shown at the bottom of the first column. Those values are also available in the model as the variable named government risk (GOVRISK).



Performance Risk Analysis - Higher Rank means greater risk

Continue Save Print Using Countries/Regions Using Absolute Evaluation Select Multiple Scenarios Select Multiple Country/Regions or Groups

Countries or Regions: Angola   Select Year: 2010

Select File: 0 - Working File, based on IFSBASE.RUN

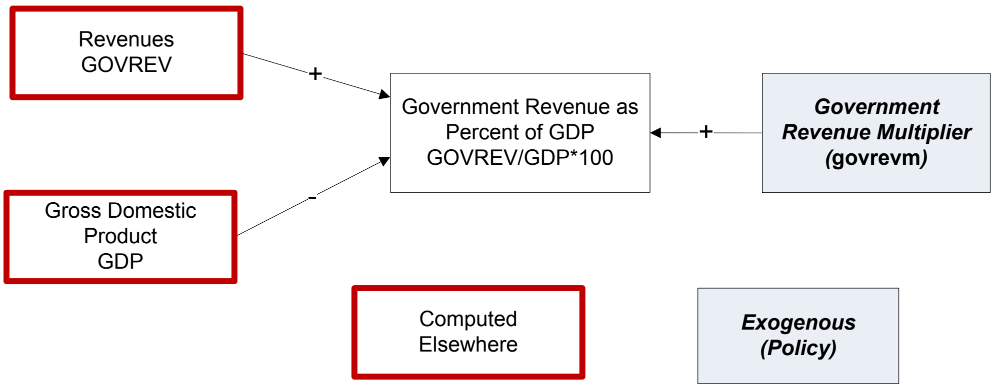
Click on variable name to get options for additional information. Click on any row Weighting to change it and on any row Rank to see a full country list.

GDP per Capita: 4.76

	Values and Ranks						Evaluation: Absolute		
	Value	Min Level	Max Level	Scaled Level	Global Rank	Weighting	Goal Level	Alert Level	Standard Deviation
Governance: Security									
Instability	0.3	0	1	0.3	5	1	0.05	0.1	-2.5
Internal war	0.6	0	1	0.6	18	1	0.05	0.1	-1.65
Governance: Capacity									
Corruption	1.9	0	10	0.81	11	1	7	3	-1
Effectiveness	1.38	0	5	0.72	26	1	2.5	1.5	-1.07
Governance: Inclusion									
Democracy	8	0	20	0.6	37	1	14	7	-0.99
Freedom	5	2	14	0.75	27	0	11	5	-1.05
Gender Empowerment Measure	0.28	0	1	0.72	25	1	1	0.4	-1.07
Risk Driver: Population									
Youth Bulge	50.83	0	100	0.51	19	1	35	47.5	-1.22
Elderly Bulge	2.48	0	100	0.02	173	0	10	16	0.97
Urbanization Rate	4.47	-10	10	0.72	21	1	3	5	-1.52
Risk Driver: Environment									
Water use/Renewable	0	0	90	0	176	1	0.2	0.4	0.24
Climate Change	0	-30	30	0.5	1	1	5	-5	0
Risk Driver: International									
Power Transition							0	0	
Peformance: Economy									
Poverty Level	0.43	0	1	0.43	29	1	0.03	0.2	-1.24
Inequality	0.51	0	1	0.51	20	1	0.35	0.45	-1.22
Resource Export Dependence	100.57	0	150	0.67	1	1	5	20	-3.92
Rate of per capita Growth	5.17	-100	100	0.47	173	1	3	1.5	1.72
Performance: Health									
Infant Mortality	102.83	0	500	0.21	8	1	15	50	-2.15
Life Expectancy	50.67	0	125	0.59	13	1	70	60	-1.87
Malnutrition	15.6	0	100	0.16	51	1	3	10	-0.41
HIV Prevalence Rate	1	0	100	0.01	35	1	0.2	1.5	-0.02
Performance: Education									
Primary Net Enrollment	30.03	0	100	0.7	4	1	80	60	-3.47
Adult Education Years	6.04	0	20	0.7	57	1	5	2	-0.56
Summary Measure	36.5			0.5	9	20			-1.2

2.3 Capacity: Government Revenues

The ability to raise government revenues (GOVREV as a share of GDP) is one of the dimensions of capacity in governance. Its basic calculation is a very simple ratio. The key drivers of GOVREV, however, documented elsewhere, are very complex. For instance, GOVREV is responsive in an equilibration process to government expenditures, both transfer payments and direct government expenditures in categories such as military, health, education, and infrastructure, as well as to external revenues, notably foreign aid receipts.

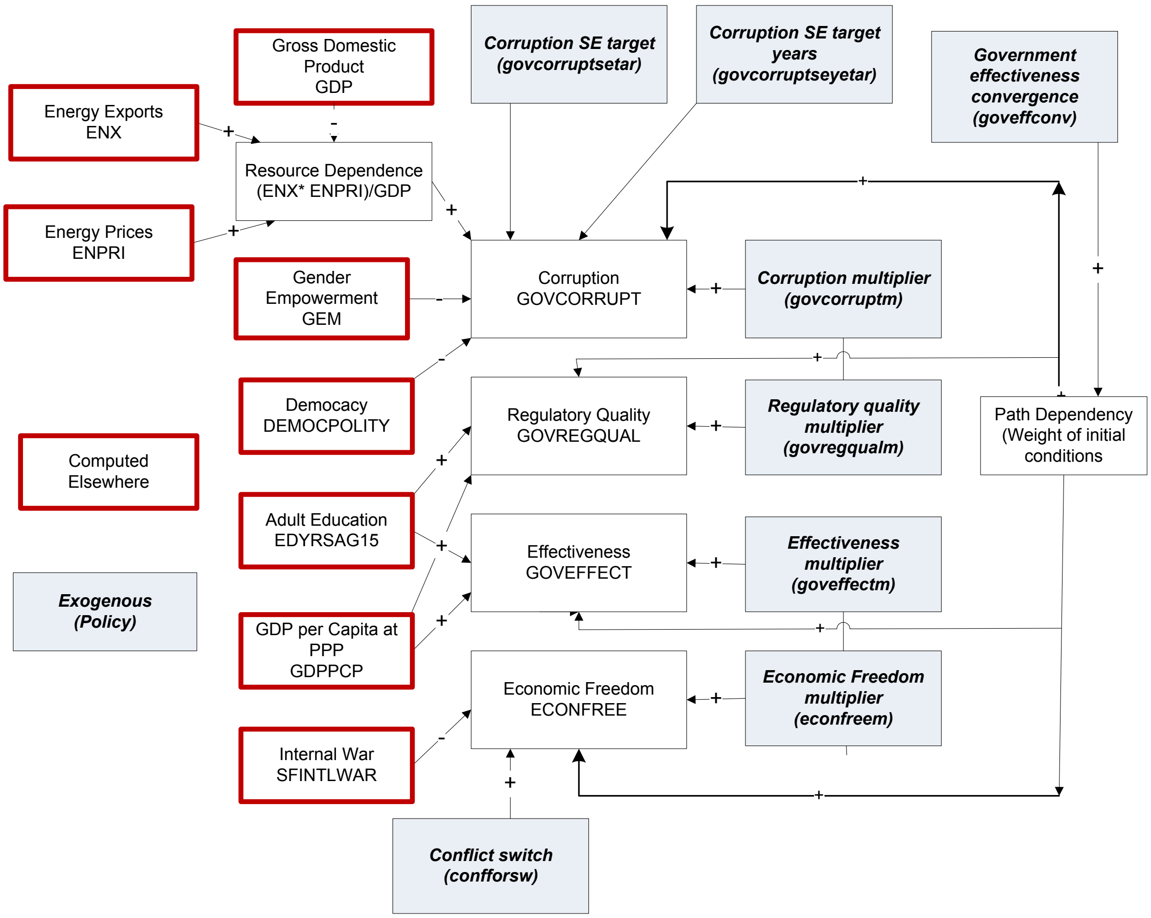


2.4 Capacity: Effectiveness of Government

The central measure of governance effectiveness in Hughes et al. (2014) was defined to be corruption or GOVCORRUPT (actually the absence thereof, or level of transparency). The model computes several additional measures of effectiveness or capacity, however, including regulatory quality (REGQUALITY) and effectiveness (GOVEFFECT), both related to the World Bank's World Governance Indicator project (Kaufmann, Kraay, and Mastruzzi 2010). In addition, many analysts point to the level of economic freedom (ECONFREE) or liberalization as a measure of effectiveness, in spite of considerable debate around their doing so.

Among the drivers of governance corruption is resource dependence, for which we use as a proxy the value of energy exports (ENX) at energy prices (ENPRI) as a share of GDP. Energy exports tend to me the largest such category globally. Further drivers are the extent of gender empowerment (GEM) and the level of democracy (DEMOCPOLITY), both of which indicate the extent of inclusiveness but which make independent statistical contributions to corruption level.

The drivers do not, of course, fully determine the level of corruption and there is much historical path dependence in societies related to other variables. The user can control the speed of elimination of such dependence and therefore of convergence to the basic formulation with a conversion years parameter (***goveffconv***).



There are times when the user will wish to introduce normatively controlled target values for corruption. One approach is use of the "brute force" multiplier on corruption (***govcorruptm***). A second approach involves the specification of target values relative to a function of the key drivers estimated cross-sectionally across countries. This second approach allows, for instance, the specification of a target level 1 or 2 standard errors (SE) above the level expected of a country given those drivers. The SE target parameter is ***govcorruptsetar*** and the ***govcorruptseyrtar*** carries the years to achieve the target. There are similar control parameters (not shown the diagram) for regulatory quality (***govregqualsetar*** and ***govreqqualseyrtar***) and for effectiveness (***goveffectsetar*** and ***goveffectseyrtar***), but not for economic freedom.

Theoretically, internal war (SFINTLWAR) could affect all of the capacity variables, but the only linkage identified in IFs is that to economic freedom. Setting the control switch (***conflforsw***) to 1 turns on that impact.

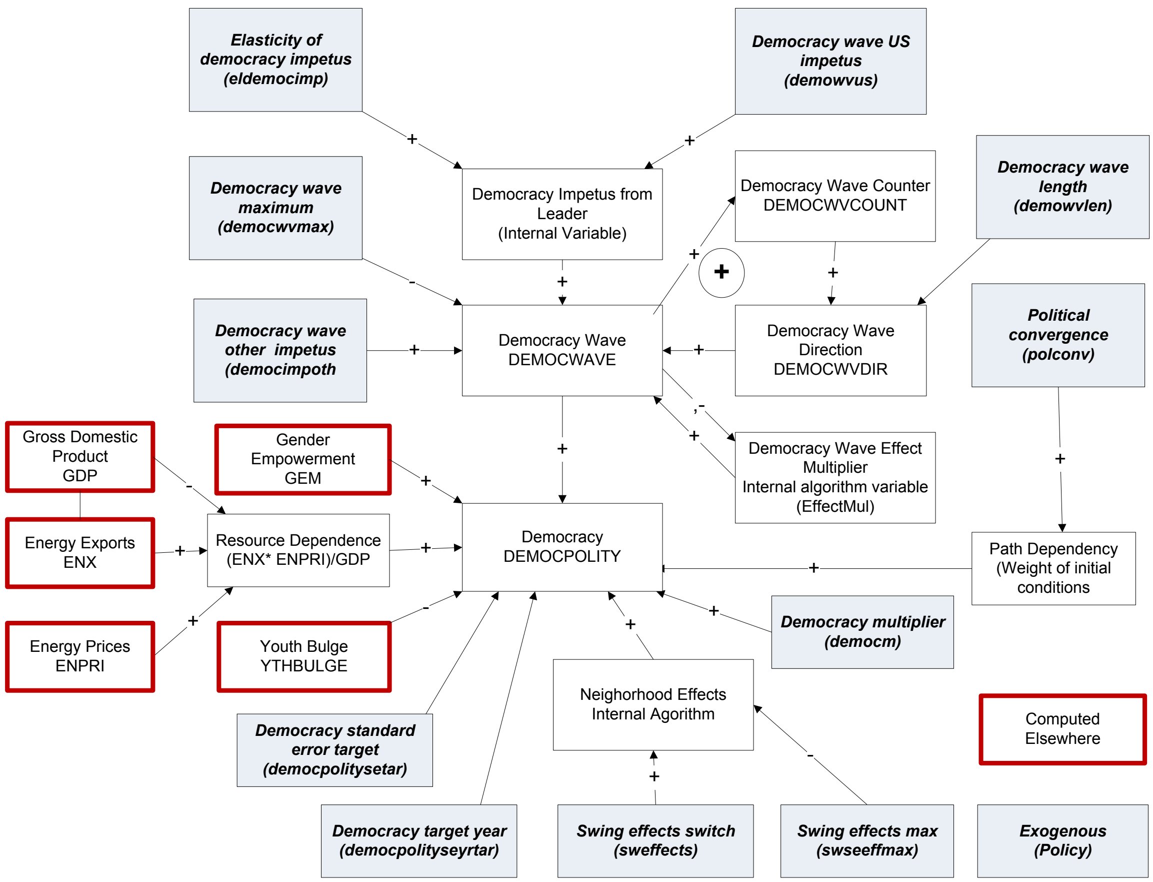
2.5 Inclusiveness: Democracy

Three variables dominate the forecasting formulation for democracy (DEMOCPOLITY): the gender empowerment measure (GEM) as a measure of broad social inclusion (positive linkage), the youth bulge (YTHBULGE) as an indicator of the age structure of society (negative linkage), and the dependence of the country on raw materials exports, a negative linkage using energy export share (ENX) times energy prices (ENPRI) as a share of the GDP as a proxy. An exogenous multiplier (***democm***) allows the user to directly manipulate the democracy level.

Two other variables can affect the democracy level but are turned off in the Base Case and will seldom be used. The first is the neighborhood effects of swing states in a regional neighborhood (e.g. Russia among former states of the Soviet Union). The swing states effect switch (***sweffects***) turns it on when set to 1.

The more complicated additional factor is that of democracy waves (DEMOCWAVE). Relative to the initial condition a democracy wave can add or subtract democracy to the basic formulation's calculation of it (an algorithm based on historical experience allows upward swings to be larger than downward ones depending on EffectMul). The basic magnitude of increments depends of an exogenous specification of the impetus provided to democracy by the leading power (***democwvus***) and by other powers (***democimpoth***), the former's impact controlled by an elasticity (***eldemocimp***). Because waves rise and ebb, another parameter controls the length (***democlen***) and still another sets the maximum rise (***democwvmax***). A counter keeps track of the running and receding of a wave (DEMOCWVCOUNT) and a pointer keeps track of the direction its operation (DEMOCWVDIR); these two parameters are linked with the magnitude of the wave in a positive loop

The calculation from the basic formulation, before the addition of wave and swing state or neighborhood effects, can also be overridden by the use of external targeting directed by specifications of standard error targets relative to the formulation (***democpolitysetar***) to be achieved by a target year (***democpolityseyrtar***).

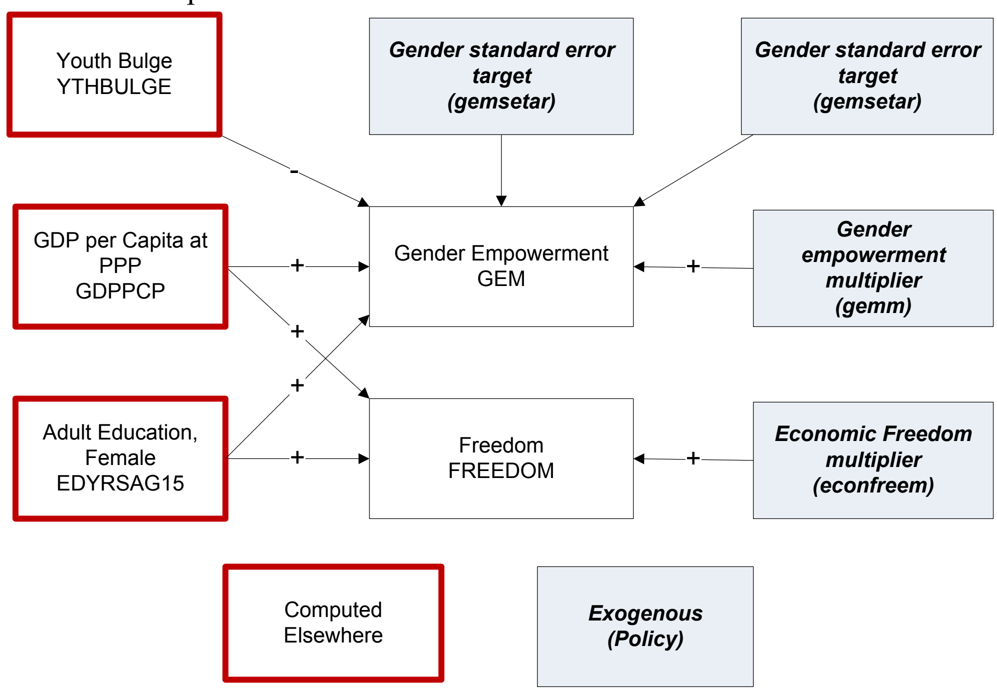

Elasticity of democracy impetus (eldemocimp)
Democracy wave US impetus (demowvus)
Democracy wave maximum (democwvmax)
Democracy Impetus from Leader (Internal Variable)
Democracy Wave Counter DEMOCWVCOUNT
Democracy wave length (demowvlen)
Democracy wave other impetus (democimpoth)
Democracy Wave DEMOCWAVE
Democracy Wave Direction DEMOCWVDIR
Political convergence (polconv)
Gross Domestic Product GDP
Gender Empowerment GEM
Democracy Wave Effect Multiplier Internal algorithm variable (EffectMul)
Energy Exports ENX
Resource Dependence (ENX* ENPRI)/GDP
Democracy DEMOCPOLITY
Path Dependency (Weight of initial conditions
Energy Prices ENPRI
Youth Bulge YTHBULGE
Democracy multiplier (democm)
Neighorhood Effects Internal Agorithm
Computed Elsewhere
Democracy standard error target (democpolitysetar)
Democracy target year (democpolityseyrtar)
Swing effects switch (sweffects)
Swing effects max (swseeffmax)
Exogenous (Policy)

2.6 Inclusiveness: Gender Empowerment and Freedom

Gender empowerment (GEM), a broader measure of inclusion, joins democracy as the second key measure of governance inclusiveness. Its three basic drivers are youth bulge size (YTHBULGE), GDP per capita as purchasing power parity (GDPPCP), and the years of formal education obtained by female adults (EDYRSAG15).

A user can control the progression of gender empowerment with a simple multiplier (***gemm***) or via setting a target value for it movement to some number of standard errors above or below a cross-sectionally estimated function (***gemsetar***) across a set number of years (***gemseyrtar***).

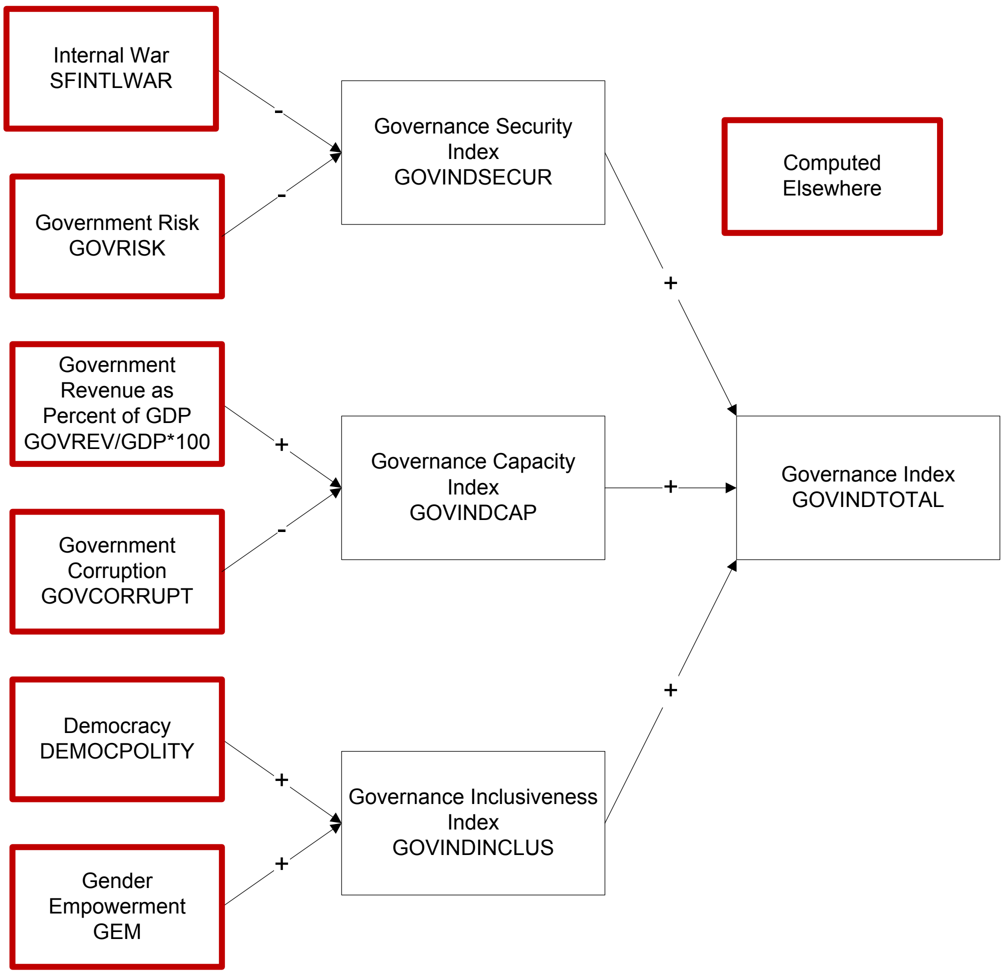
Although IFs uses the Polity measure of democracy (DEMOCPOLITY) as its main measure of more formal, electoral inclusion, Freedom House's freedom measure (FREEDOM) is a logical alternative and the second of that measure's sub-dimensions, civil liberties, is a more inclusive measure. We therefore compute it also, using again GDP per capita and educational years (of all adults, not just females) as drivers. And there is a brute force multiplier for it also (***freedomm***). There is no SE targeting mechanism in place for the freedom variable.



2.7 Aggregate Governance Indicators

The major way of exploring the possible future of the three dimensions of governance is separately to use the two variables that represent each. But it is also useful to have more aggregate indices, first for each dimension and also across the three.

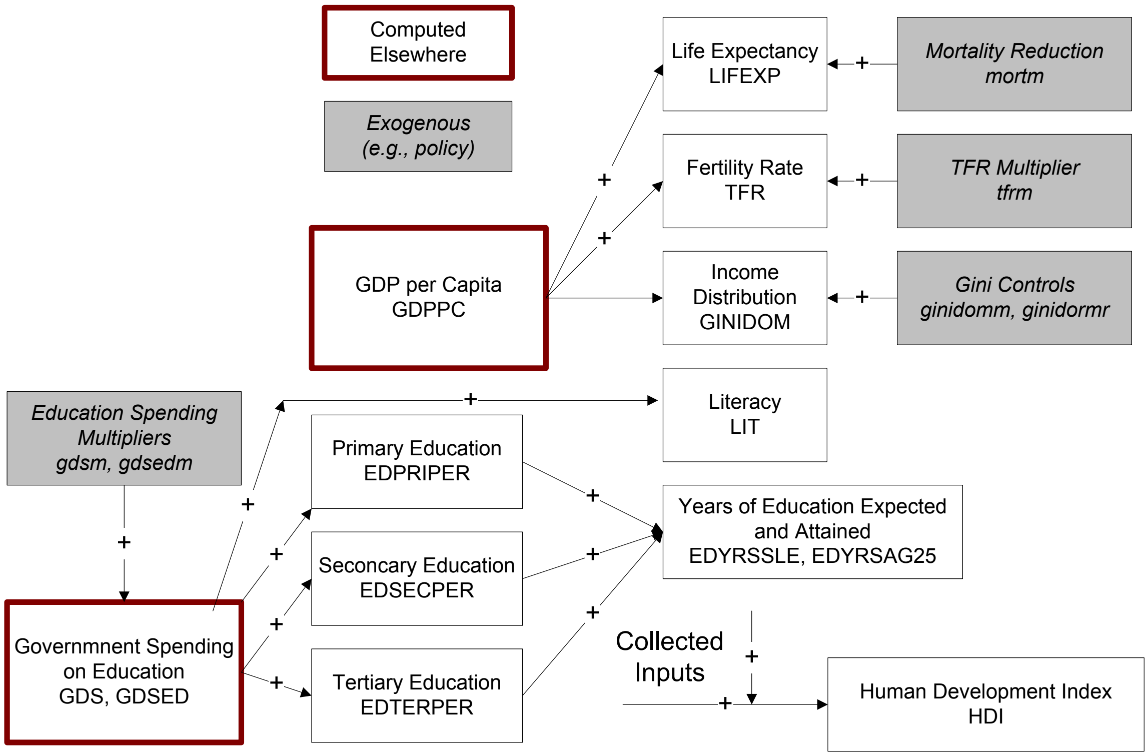
The governance security index (GOVINDSECUR) is computed as an unweighted average of internal war probability (SFINTLWAR) and governance/society performance risk (GOVRISK). Similarly, the governance capacity index (GOINDCAP) is an unweighted average of government revenue (GOVREV) as a portion of GDP and government corruption, while the governance inclusion index (GOVINCLIND) averages democracy (DEMOCPOLITY) and gender empowerment (GEM). The overall governance index (GOVINDTOTAL) is a simple average of those across dimensions.



In reality, creating the indices for each dimension requires some attention to scaling issues and valence. See the description of the equations for details.

2.8 Life Conditions and the Human Development Index

The condition of individuals and society are both the ultimate focus of governance and the font of it. The IFs system computes many of the relevant variables across its various models. It also aggregates a number of those into the widely used Human Development Index (HDI), based on heath (life expectancy), education or knowledge (both expectations for youth and attainment for adults), and GDP per capita.



2.9 Social Values and Cultural Evolution

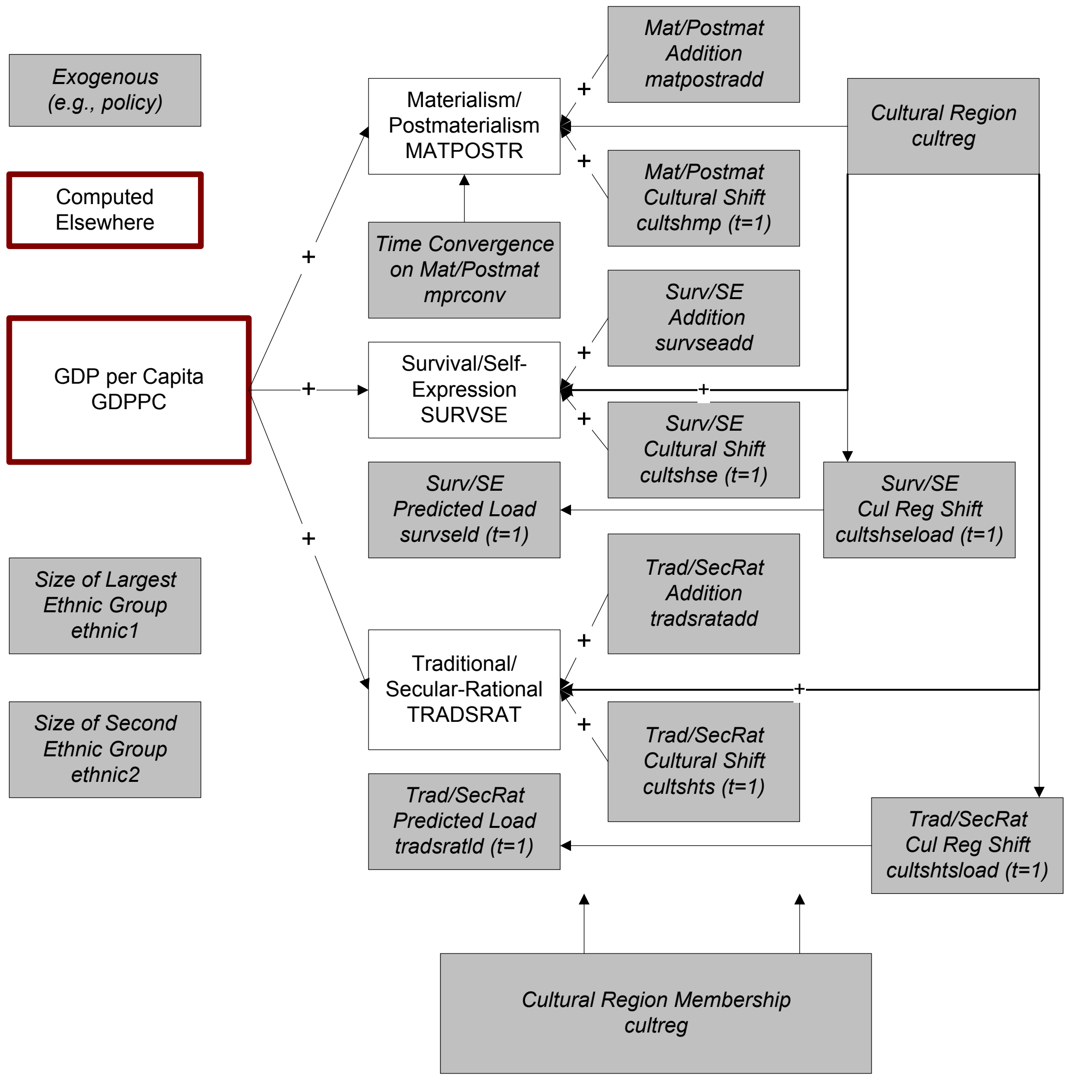
Understanding societies fully requires going even more deeply than their governance and social conditions in order to look at the values and cultural foundations. IFs computes change in three cultural dimensions identified by the World Values Survey (Inglehart 1997). Those are dimensions of materialism/post-materialism, survival/self-expression, and traditional/secular-rational values.

Inglehart has identified large cultural regions that have substantially different patterns on these value dimensions and IFs represents those regions, using them to compute shifts in value patterns specific to them.

Levels on the three cultural dimensions are predicted not only for the country/regional populations as a whole, but in each of 6 age cohorts. Not shown in the flow chart is the option, controlled by the parameter "***wvsagesw***," of computing country/region change over time in the three dimensions by functions for each cohort (value of ***wvsagesw*** = 1) or by computing change only in the first cohort and then advancing that through time (value of ***wvsagesw*** = 2).

The model uses country-specific data from the World Values Survey project to compute a variety of parameters in the first year by cultural region (English-speaking, Orthodox, Islamic, etc.). The key parameters for the model user are the three country/region-specific additive factors on each value/cultural dimension (***matpostradd***, etc.).

Finally, the model contains data on the size (percentage of population) of the two largest ethnic/cultural groupings. At this point these parameters have no forward linkages to other variables in the model.



3. Governance Equations

Like the block diagrams for governance in IFs, the equations fall into the categories of the three dimensions (security, capacity, and inclusion), with detail for each of two sub-dimensions on each.

3.1 Governance security dimension equations

IFs represents two different types of measures related to domestic conflict and security. The first has roots in the work of the Political Instability Task Force (PITF); see Esty et al. (1998) and Goldstone et al. (2010). The PITF database allows us to see the actual pattern of conflict in countries over time and to use that historical conflict pattern to compute an initial probability of conflict. The second type of measure includes indices of vulnerability to conflict, generally presented in terms of rankings of countries with respect to their vulnerability (see Chapter 2 of Hughes et al. 2014, especially Box 2.3). Because these indices are not rooted as solidly in past conflict patterns, we cannot interpret their values or the rankings based on them as probabilities of conflict, but rather as propensities for conflict (and as indicators more generally of country performance and risk).

In order to establish forecasting approaches for both types of measures within IFs, we looked to earlier work (see Chapter 3 of Chapter 2 of Hughes et al. 2014), did our own statistical analysis to create an underlying base formulation for overt conflict probability, and augmented the basic approach via more algorithmic elements—algorithms or logical procedures, like recipes, help guide forecasting through steps that analytical functions cannot easily represent. The algorithmic elements are tied in part to our efforts to fit the IFs forecasting approach at least relatively well to historical data from 1960 through 2010. Chapter 4 of Hughes et al. 2014 elaborates more fully the development process for the representation of security provided in this Help system.

3.1.1 Equations: Internal conflict or war probability

The PITF defined state failure in terms of four different types of events (with specific magnitude thresholds)—namely, adverse regime change (such as coups), revolutionary wars, ethnic wars, and genocides or politicides (Esty et al. 1998). On the recommendation of Ted Robert Gurr, one of the founding fathers of the PITF data project and approach, IFs builds two categories of insecurity from those four types: instability (adverse regime change); and internal war (combining revolutionary war, ethnic war, and genocide or politicide).

Presence of any one of the three types of war, either as an initiation or continuation, leads us to code a country as 1; otherwise we code the country as 0. This distinction between instability and internal war helps differentiate among what Easton (1965) identified as regime, state, and polity levels within the sociopolitical system, by at least differentiating the regime level (where adverse regime changes occur) from the more fundamental state and polity levels. The forces of change and generally the extent of violence around change differ significantly at these different levels

Looking at the historical patterns of conflict in global regions across time (see Chapter 4 of Hughes et al. 2014) and doing our own statistical analysis it is clear that the "usual suspect" variables will not explain those patterns, and that in many cases they cannot therefore be very effective in forecasting. We found:

- Normed infant mortality proves statistically interesting, being associated with (explaining or being explained by, using a second-order polynomial form) about 12 percent of cross-country variation in intrastate conflict in the most recent data-year (8.9 percent in panel analysis across the 1960–2000 period). Thus in forecasting it may help us understand general propensity for conflict, but its slow variation over time means it cannot possibly explain the big historical surges of warfare within regions and their country members.

- Trade openness (which we define as the sum of exports and imports as a percentage of GDP) can be helpful in understanding variations in conflict and does vary within countries more rapidly than infant mortality. In cross-sectional analysis with most recent data, infant mortality and trade openness (inverse relationship) together account for 15 percent of the variation in intrastate conflict (trade openness itself is associated with 11 percent of the variance within intrastate conflict in a logarithmic formulation). Moreover, its increase coincides with the reduction of conflict historically within the countries of East Asia. But openness perversely increased over time in South Asia as intrastate conflict also rose. And its statistical power is good but not great. Again, causality could run in either direction or be a spurious result of a third variable; for instance, the end of Indochina wars and a change in economic policy in socialist countries could have led to greater trade there.

- Factionalism, which can have many bases, including ethnicity or the intensity of feelings around ethnicity, is of surprisingly little use in forecasting. Most underlying social divisions change very slowly over time. Although intensity of factionalism around those divisions may change much more rapidly (for instance, as "conflict entrepreneurs" inflame passions), we arguably cannot anticipate when that might happen. Nor do we believe we can we anticipate changes in other potential ideational drivers, such as ideologies. Further, historical measurement of change in factionalism risks using conflict as a proxy, thereby creating the danger that correlations between it and conflict are simply a tautological artifact of that measurement. Finally, our own analysis of various measures of ethnic and/or religious factionalism and intrastate conflict suggests lower relationship than we expected.

- Youth bulges are a potentially more useful driver in forecasting because our demographic forecasts are stronger than those of variables like factionalism or even trade openness, and because demographic structures exhibit clear and non-monotonic variation over time. There were many bulges in East Asia during the 1970s, as there have been many recently in South Asia and as there are today in the Middle East and North Africa. In cross-sectional analysis of recent data, a linear relationship with youth bulge size accounts for 7 percent of the variation in conflict (in panel analysis since 1960, however, only 3.5 percent).

- Consistent with studies that have found anocracy rather than autocracy primarily related to conflict, the relationship of measures of regime type with conflict has an inverted U-shaped character. Using a third-order polynomial, we found that the Polity measure of regime type explains 4 percent of variation in recent intrastate war. The Freedom House measure (see http://www.freedomhouse.org/) actually explains 10 percent, but we used the Polity Project measure (see http://www.systemicpeace.org/polity/polity4.htm) because it is a purer measure of political democracy (rather than civil liberties as well) and because it is our primary measure of regime in forecasting.

- Downturns in economic growth rates preceded the collapse of communism in Europe and Central Asia, the rise of internal conflict in both Latin America and the Middle East in the 1980s, and more recently the events of the Arab Spring. Analysis of the magnitude of downturn required to generate conflict and the lag between downturn and conflict is complex. We found, through experimentation directed at fitting historical conflict patterns (running IFs against historical patterns since 1960), that a 1.0 percent drop in a moving average of economic growth (carrying 60 percent of the moving average forward) is associated with a 0.04 point increase on a 0-1 scale for the rate of internal war.

- Conflict begets conflict. We found, again through historical analysis, a 60 percent carryover of past conflict levels to current ones.

For IFs forecasting, we conceptualize and operationalize intrastate war not as a 0 or 1 outcome as in the data (no war or war), but as a probability of conflict in any country-year. We initialize country probabilities at the beginning of a forecast horizon with average conflict rates across the preceding 20 years. The development of our own basic forecasting formulation for these probabilities involved not just literature and statistical analysis, but testing of the formulation in runs of the model from 1960 through 2010 and comparisons of our historical forecasts with the data on intrastate war. We let the historical forecasts run without the frequently used annual adjustment/correction by the historical conflict data for the full 50 years. We experimented with a number of algorithmic elements in order to improve the historical fit. This analysis yielded the following basic formulation:

$$SFINTLWAR_{r,t} = \Big(\big(0.1420 + 0.0012 * INFMOR_{r,t} - 0.0006 * TRADEOPEN_{r,t}\big) + F\big(POLITYDEMOC_{r,t}, YTHBULGE_{r,t}, GDPMA_{r,t}, SFINTLWARMA_{r,t}\big)\Big) * \boldsymbol{sfintlwarm_{r,t}}$$

where

$$TRADEOPEN_{r,t} = (X_{r,t} + M_{r,t})/GDP_{r,t}$$

SFINTLWAR=probability of internal war or state failure
INFMOR=infant mortality, normed globally
TRADEOPEN=trade openness ratio
X=exports in billion dollars
M=imports in billion dollars
GDP=gross domestic product in billion dollars
POLITYDEMOC=Polity's 21-point scale of democracy; asymmetrical curvilinear relationship with a peak at 9 and a sharper fall than rise
YTHBULGE=population age 15–29 as a portion of all adults; algorithmic adjustment with GDP/capita explained in text
GDPRMA=gross domestic product growth rate, algorithmic moving average carrying forward 60 percent past year's value; algorithmic adjustment with GDP/capita explained in text; inverse relationship
SFINTLWARMA=moving average of past internal war probability (i.e., carrying forward past forecast values, not past data values)
sfintlwarm=an exogenous multiplier for scenario analysis
Algorithm on regional contagion explained in text
R-squared = 0.22 in 50-year historical simulation without annual correction (see text for elaboration)

Our historical and extended analytical explorations of the core statistical formulation with infant mortality and trade openness led us to make a number of algorithmic changes to it in creating our basic formulation. We found that $18,000 per capita (in 2005 dollars at PPP) is a point above which economic downturns and youth bulges tend not to increase the probability of internal war, so we greatly dampened the affects of both of those variables above that level. We also found it important to add a regional contagion effect; courtesy of data provided by Paul Diehl we combined three of the Correlates of War Project distance categories (contiguous, less than 12 miles separation, and less than 24 miles separation) and added 0.1 to conflict probability for a country for each neighbor with computed conflict probability of its own above 0.2— because of conflict carryover across time, this algorithm can also lead to a positive feedback loop of neighborhood contagion.

We further found that the intrastate war formulation is sensitive to actual GDP levels, not just because of the growth rate term, but because within the broader IFs system GDP per capita also affects the endogenously calculated youth bulge and democracy variables (we will return to discussion of the latter). To deal with this sensitivity, we forced the IFs historical base to be historically accurate with respect to GDP growth—otherwise the entire historical forecast of IFs after 1960 was endogenously determined in recursive annual calculation only by initial conditions and formulations rather than with annual corrective terms often used in historical validation exercises.

This basic initial formulation generated a pattern of historical forecasts (which can be generated using the file HistoricalNoMassRepOrExtInterv.sce) of intrastate warfare probabilities that showed some of the characteristics of the historical data, including a peak for the Middle East and North Africa in the 1980s and one for developing Europe and Central Asia in the early 1990s (both related to growth downturns). Visual comparison quickly suggested, however, that the overall pattern was not a good historical fit. In particular, the bulges of conflict in East Asia in the early years and of South Asia more recently were missing; in addition, because of the infant mortality and economic growth terms, the model generated a bulge of conflict within Africa in the early 1980s (when growth and social advance was very weak) that did not appear in the data. Moreover, statistically, the forecasts correlated at the region level with data across the 1960-2010 time period with only a 0.19 R-squared level.

We therefore explored the bases of the historical patterns further, and concluded that additional factors were missing. One is the extreme or totalitarian repression that lowered conflict in developing Europe and Central Asia until about the time of General Secretary Mikhail Gorbachev; we added a repression parameter (***wpextinterv***) for exogenous manipulation. More controversially perhaps, we also found it necessary to extend the suppression of conflict to sub-Saharan Africa in the middle period of the historical run; the underlying assumption is that the domestic prestige and power of liberation movement leaders, backed by their domestic and superpower supporters, helped dampen conflict significantly in the face of poor, and even deteriorating, domestic economic and social conditions.

A second type of factor missing in our basic statistical analysis is external interventions, such as those of the U.S. in Southeast Asia in the 1960s and those of the former USSR and then the U.S. in South Asia after 1980; we added another exogenous parameter (***sfmassrep***) to represent such interventions.

Although still not a terribly strong match to actual history, this revised historical forecast some remarkable similarities, including the initially high level of conflict in East Asia and the Pacific and a relatively high rate for South Asia in recent decades. The adjusted R-squared rises to 0.61 from 0.19 (before the addition of the repression and intervention variables). The major problems that remained in our historical forecast include the generation by the model of too much conflict for Latin America and the Caribbean in the 1980s, when economic and social conditions in that region deteriorated significantly; and the relatively high levels of conflict in sub-Saharan Africa beyond the end of the Cold War, again associated in our forecast with a combination of absolute and relative deterioration in socioeconomic conditions of many countries. Thus the additional parameters may be useful in scenario analysis.

It is possible that our relatively high historical forecasts for conflict in post-Cold War sub-Saharan Africa, even after formulation enhancements, may reflect the remaining omission of yet another systemic variable, namely regional and global efforts to dampen conflict there. There is no parameter to represent that variable, but the user can use the overall multiplier (***sfintlwarm)*** in scenario analysis.

3.1.2 Equations: Political Stability/Instability

The State Failure project has analyzed the propensity for different types of state failures within countries, including those associated with revolution, ethnic conflict, genocide-politicide, and abrupt regime change (using categories and data pioneered by Ted Robert Gurr. Upon the advice of Gurr, IFs groups the first three as internal war and the last as political instability. The model formulations for political instability are older and less well developed than those for internal war; we therefore recommend focus on internal war. Nonetheless, we document the approach to instability here.

The extensive database of the project includes many measures of failure. IFs has variables representing the probability of the first year or a continuing year of instability (SFINSTABALL) and the magnitude of a first year or continuing event (SFINSTABMAG).

Using data from the State Failure project, formulations were estimated for each variable using up to five independent variables that exist in the IFs model: democracy as measured on the Polity scale (DEMOCPOLITY), infant mortality (INFMOR) relative to the global average (WINFMOR), trade openness as indicated by exports (X) plus imports (M) as a percentage of GDP, GDP per capita at purchasing power parity (GDPPCP), and the average number of years of education of the population at least 25 years old (EDYRSAG25). The first three of these terms were used because of the state failure project findings of their importance and the last two were introduced because they were found to have very considerable predictive power with historic data.

The IFs project developed an analytic function capability for functions with multiple independent variables that allows the user to change the parameters of the function freely within the modeling system. The default values seldom draw upon more than 2-3 of the independent variables, because of the high correlation among many of them. Those interested in the empirical analysis should look to a project document (Hughes 2002) prepared for the CIA's Strategic Assessment Group (SAG), or to the model for the default values.

One additional formulation issue grows out of the fact that the initial values predicted for countries or regions by the six estimated equations are almost invariably somewhat different, and sometimes quite different than the empirical rate of failure. There may well be additional variables, some perhaps country-specific, that determine the empirical experience, and it is somewhat unfortunate to lose that information. Therefore the model computes three different forecasts of the six variables, depending on the user's specification of a state failure history use parameter (***sfusehist***). If the value is 0, forecasts are based on predictive equations only. The equation below illustrates the formulation. The analytic function obviously handles various formulations including linear and logarithmic.

if ***sfusehist*** =0 then (no history)

$$SFINSTABALL_{r,t} = PredictedTerm_{r,t}$$

where

$$PredictedTerm_{r,t} = ANALFUNC(GDPPCP_{r,t}, DemocTerm_t, InfMorTerm_t, TradeTerm_t, Educ25Term_t)$$

$$DemocTerm = DemoPolity_r$$

$$InfMorTerm = \frac{INFMOR_r}{WINFMOR}$$

$$TradeTerm = \frac{X_r + M_r}{GDP} * 100$$

$$Educ25Term = EDYRSAG25_r$$

If the value of the sfusehist parameter is 1, the historical values determine the initial level for forecasting, and the predictive functions are used to change that level over time. Again the equation is illustrative.

if ***sfusehist*** =1 then (use history)

$$SFINSTABALL_{r,t} = \frac{PredictedTerm_{f,t}}{PredictedTerm_{f,t=1}} * \boldsymbol{SFINSTABALL}_{r,t=1}$$

where

$$PredictedTerm_{r,t} = ANALFUNC(GDPPCP_{r,t}, DemocTerm_t, InfMorTerm_t, TradeTerm_t, Educ25Term_t)$$

$$DemocTerm = DemoPolity_r$$

$$InfMorTerm = \frac{INFMOR_r}{WINFMOR}$$

$$TradeTerm = \frac{X_r + M_r}{GDP} * 100$$

$$Educ25Term = EDYRSAG25_r$$

If the value of the ***sfusehist*** parameter is 2, the historical values determine the initial level for forecasting, the predictive functions are used to change the level over time, and the forecast values converge over time to the predictive ones, gradually eliminating the influence of the country-specific empirical base. That is, the second formulation above converges linearly towards the first over years specified by a parameter (***polconv***), using the CONVERGE function of IFs.

if ***sfusehist*** =2 then (converge)

$$SFINSTABALLBase_{r,t} = \frac{PredictedTerm_{f,t}}{PredictedTerm_{f,t=1}} * \boldsymbol{SFINSTABALL}_{r,t=1}$$

$$SFINSTABALL_{r,t} = ConvergeOverTime(SFINSTABALLBase_{r,t}, PredictedTerm_{f,t}, \boldsymbol{polconv})$$

where

$$PredictedTerm = ANALFUNC(GDPPCP_{r,t}, DemocTerm_t, InfMorTerm_t, TradeTerm_t, Educ25Term_t)$$

$$DemocTerm = DemoPolity_r$$

$$InfMorTerm = \frac{INFMOR_r}{WINFMOR}$$

$$TradeTerm = \frac{X_r + M_r}{GDP} * 100$$

$$Educ25Term = EDYRSAG25_r$$

3.1.3 Equations: Vulnerability to conflict (and performance risk analysis)

The second approach to analyzing risk of violent internal conflict (and broader country risks) involves the creation of indices that tend to rank states according to generalized performance. The projects creating such indices—variously referred to as measures of state fragility, state weakness, political instability, or failed states—most often do not intend to convey a probability of violent internal conflict. Rather they try to suggest greater or lower propensities for conflict as well as broader country risk, for instance that which foreign investors might face with respect to socioeconomic conditions. .

Generally, these indices combine variables in four categories: social, political, economic, and security. Developers may supplement variables that mostly focus on the average values for countries with select variables focusing on distribution (such as the Gini index). They commonly weight variables within categories equally and/or weight the categories equally when aggregating them to final index values. While individual variables have theoretical and empirical links to conflict or lack of security, such simple combination of large numbers of highly intercorrelated variables into a formulation of conflict vulnerability is very difficult to interpret. Moreover, because reports generally present an index with no simple interpretation of scale, analysts focus heavily on rankings of countries.

The IFs project has created its own Performance Risk Index (see variable GOVRISK) along the lines of these approaches, and for the purposes of forecasting has uniquely made it responsive to endogenous long-term change in the underlying variables. Like those of other projects, the IFs measure draws upon social, political, economic, and security variables, but we impose a different conceptual or analytical structure on them (see the example risk analysis form provided here). We divide the variables of the index into three general categories: governance, (deep) risk drivers, and performance. We further divide the governance variables into our three dimensions of security, capacity and inclusion, the deep risk factors into demographic, environmental, and international categories, and the performance factors into economic, health, and education categories.

Performance Risk Analysis - Higher Rank means greater risk

Continue Save Print Using Countries/Regions Using Absolute Evaluation Select Multiple Scenarios Select Multiple Country/Regions or Groups

Countries or Regions: Angola Select Year: 2010
Select File: 0 - Working File, based on IFSBASE.RUN

Click on variable name to get options for additional information. Click on any row Weighting to change it and on any row Rank to see a fully country list.
Income per Capita: 4.77

	Risk Index	Value	Standard Errors	Alert Level	Goal Level	Min Level	Max Level	Rank	Weighting
Governance: Security									
Instability	0.3	0.3	-2.5	0.1	0.05	0	1	5	1
Internal war	0.6	0.6	-1.65	0.1	0.05	0	1	18	1
Governance: Capacity									
Corruption	0.81	1.9	-1	3	7	0	10	11	1
Effectiveness	0.72	1.38	-1.07	1.5	2.5	0	5	26	1
Governance: Inclusion									
Democracy	0.6	8	-0.99	7	14	0	20	37	1
Freedom	0.75	5	-1.05	5	11	2	14	27	0
Gender Empowerment Measure	0.72	0.28	-1.07	0.4	1	0	1	25	1
Risk Driver: Population									
Youth Bulge	0.51	50.83	-1.22	47.5	35	0	100	19	1
Elderly Bulge	0.02	2.48	0.97	16	10	0	100	173	0
Urbanization Rate	0.72	4.47	-1.57	5	3	-10	10	19	1
Risk Driver: Environment									
Water use/Renewable	0	0	0.24	0.4	0.2	0	90	176	1
Climate Change	0.5	0	0	-5	5	-30	30	1	1
Risk Driver: International									
Power Transition				0	0				
Peformance: Economy									
Poverty Level	0.43	0.43	-1.24	0.2	0.03	0	1	29	1
Inequality	0.51	0.51	-1.22	0.45	0.35	0	1	20	1
Resource Export Dependence	0.67	100.77	-3.86	20	5	0	150	1	1
Rate of per capita Growth	0.47	5.27	1.78	1.5	3	-100	100	173	1
Performance: Health									
Infant Mortality	0.22	109.5	-2.43	50	15	0	500	5	1
Life Expectancy	0.61	49.32	-2.07	60	70	0	125	9	1
Malnutrition	0.16	15.6	-0.42	10	3	0	100	51	1
HIV Prevalence Rate	0.01	1	-0.02	1.5	0.2	0	100	34	1
Performance: Education									
Primary Net Enrollment	0.7	30.03	-3.47	60	80	0	100	4	1
Adult Education Years	0.7	6.05	-0.55	2	5	0	20	57	1
Summary Measure	0.5	36	-1.22					8	20

The Performance Risk Index (GOVRISK) and the probability of intrastate conflict (SFINTLWAR) provide quite different images of security in states, in part because the probability of intrastate war has a power-law distribution across countries and risk indices have a more nearly linear distribution (see Chapter 2 of Hughes et al 2014). In 2010 the correlation between the two measures in IFs has an adjusted R-squared of only 0.25. Presumably the probability of conflict measure should be the better indicator of its likelihood. In fact, beyond their drawing our attention to the highest ranked and therefore most fragile countries, risk indices seldom are used to identify conflict likelihood and more often suggest a wider variety of risks, including overall poor state performance, only some of which may be so severe as to lead to conflict.

Because vulnerability or risk indices often include GDP per capita or other highly correlated indicators, they generally assign greater risk to poorer countries. Another way of using such risk information it to compare performance of countries to expectations that control for their level of GDP per capita (with a cross-sectional analysis). The column in the Performance Risk Analysis form showing standard errors helps us do that. In 2010 Angola's performance on infant mortality was 2.4 standard errors worse than the expected value. Thus its performance on that variable was not only very poor relative to other countries around the world, but also relative to countries at its own income level.

Unlike our analysis with the probability of conflict, it is not possible to compare the IFs Governance Risk Index with other measures across the full 1960–2010 historical time period, because those other measures tend to be quite recent and to cover only a small number of years. For instance, the Brookings Institution's Index of State Weakness for the Developing World (Rice and Patrick 2008) was produced only for a single year (2008). The measures with the greatest time series are the Fund for Peace's Index of State Failure (2005–2012) and the Center for Systemic Peace's (CSP's) State Fragility Index (1995-2011); see Marshall and Cole 2008; 2009; 2011). In order to assess the risk index of IFs, we again did a historical run of the model, without any extraordinary interventions, from 1960 through 2010—the run computes the IFs Country Performance Risk Index for all years. The R-squared of 0.71 indicates the remarkably close correlation, even after 50 years of forecasting with the full integrated IFs model. In fact, the R-squared is 0.70 across all years for which the SFI is available.

For much more detail on the structure and computations of the Performance Risk Analysis form, see the separate discussion of it (see Section 4).

3.2 Governance capacity dimension equations

The capacity dimension has two primary elements. The first is the ability to raise revenue. The second is the effective use of it and the other tools of government—that is, the competence or quality of governance.

3.2.1 Equations: Government finance

Government finance in IFs sits within a broader social accounting matrix (SAM) structure that accounts for, and in the process balances, all domestic and international financial exchanges among firms, households, and governments. The IFs system is unique, not only in the representation of flows within and across so many countries of the world, but also in maintaining, insofar as the sparse data allow, stocks (accumulations of net flows, such as government debt and assets of firms) that provide signals for equilibration processes that require changes in flows (like revenues and expenditures) over time. Like the goods and services markets of the economic model, the government finance representation in IFs (its representation of revenues and expenditures) does not seek an exact equilibrium in every time point, but rather chases equilibrium over time. The variables computed (see the links) are GOVREV, GOVEXP (with direct government consumption or GOVCON as a subset), and GOVBAL. This approach is both more realistic and more computationally efficient.

The desired IFs treatment of government is of consolidated or general government. Beyond our use of the OECD's general government expenditure data for its members, however, our main data source for finance is the World Bank's World Development Indicators (Kaufmann, Kraay, and Mastruzzi 2010), which appear to provide mostly data for central government. In fact, for most countries there are quite incomplete and inconsistent systems of national accounts on which to build social accounting matrices generally, or a full mapping of government finance more specifically. Thus the "preprocessor" in IFs plays a big role in creating a consistent and complete initial image of government finance.

With respect to government finance and the SAM more generally, the preprocessor both fills holes for missing data series of many countries, using cross-sectionally estimated functions or algorithms, and otherwise cleans and balances the SAM data. The preprocessor first builds on data to estimate total governmental revenues and expenditures for the model's base year and then uses available data on the breakdown of revenues and expenditures to calculate initial values of those streams consistent with the totals. Those who wish to understand the entire social accounting system, both initialization and forecast, should look to Hughes and Hossain (2003). More generally, the IFs preprocessor's computational rules assist in the initialization of all models within the IFs system and the connections among them, including reconciliation of physical systems such as energy and agriculture with financial ones.

We make simplifying assumptions to move from limited data to initial values for total general government expenditures and revenues of all countries as a percentage of GDP. For OECD countries we have general government expenditure data (from the OECD), and we assume that the general government revenue share of GDP differs from the expenditures share by the same percentage as central government expenditure and revenue shares differ in WDI data; the implicit assumption is that local government expenditures and revenues are in balance For non-OECD countries we have only central government expenditures and revenues, and we estimate a size for local government revenues and expenditures that rises progressively from 2 percent for the lowest income countries to 14 percent for high-income countries—the latter being the contemporary average of OECD countries, and both the former and the rise being apparent in the data and discussion of North, Wallis, and Weingast (2009: 10).

In the forecasting itself, there is similar attention to revenues and expenditures, but also attention to the cumulative imbalance between them and how that imbalance affects their dynamics over time. The model represents five revenue streams from taxes on household and firm income: household income taxes, household social security/welfare taxes, firm income taxes, firm social security/welfare taxes, and indirect taxes. In the absence of cross-country data on other revenue streams such as property taxes, the preprocessor allocates them in the base year to household taxes, a category for which data are especially weak. Total domestic government revenue is computed from the five streams. Foreign assistance augments domestic revenue in computing the fiscal balance with expenditures.

Government expenditures (GOVEXP) combine direct consumption expenditures (GOVCON) and transfer payments, especially to households (GOVHHTRN). Direct government consumption as a portion of GDP is computed from functions linking GDP per capita (PPP) to key elements of spending such as military, health, and education; total government consumption generally rises with GDP per capita. An additional optional term in the equation is a Wagner term (set to zero in the Base Case), after the discoverer of the long-term behavioral tendency for government consumption to rise as a share of GDP. The final division of government consumption into target destination categories, namely military, education, health, research and development, infrastructure (two subcategories) and an "other" or residual category, depends on a combination of functions and broader algorithmic and modeling elements specific to each spending category (including, for instance, demand for expenditures from the education and infrastructure models). The model normalizes across spending categories to assure that they equal total government consumption.

As a general rule, transfer payments grow with GDP per capita more rapidly than does direct government consumption. And within the category of transfer payments, pension payments grow especially rapidly in many countries, particularly in more economically developed ones. Computation of government transfers involves integrating two different behavioral logics, a top-down one depending on general relationships to income and a bottom-up one. The bottom-up logic is especially important in the analysis of pensions, because it is responsive to the changing size of the elderly population.

With completed computations of revenues and expenditures, it is possible to compute the government fiscal balance, an annual flow variable. That allows the update of cumulative government financial assets or debt and a calculation of their magnitude relative to GDP. IFs uses this cumulative total as a percentage of GDP in its equilibrating dynamics for annual government revenues and expenditures.

3.2.2 Equations: Broader regime capacity

Forecasting of variables that relate to broader regime capacity in IFs has three elements: (1) a basic statistical formulation; (2) a recognition of country-specific differences (tied in part to path dependencies); (3) an algorithmic linkage to internal conflict. A fourth potential element could be factors external to the country including global waves and neighborhood effects, but we introduce those only through scenario analysis.

Corruption is one of the most powerful indicators of capacity (or more accurately, lack of capacity) as well as accountability. We rely in our analysis on the Transparency International index of corruption perceptions (CPI), which is actually a measure of transparency (higher values are more transparent or less corrupt). The basic formulation in IFs for corruption/transparency (below) contains four statistically significant drivers, which collectively account for nearly 80 percent of the cross-country variation in corruption in the most recent year of data. The first term, and the one identified with the most variation, involves a variable representing long-term development, namely GDP per capita (years of education plays that same role in forecasting formulations for some other governance variables, such as democracy).

Interestingly, a second very powerful driving variable is the Gender Empowerment Measure (GEM), which, in spite of its high correlation with GDP per capita, makes its own contribution and suggests the power of inclusion in affecting capacity. In fact, still another driving variable is the extent of democracy, further suggesting the power that inclusion may have to increase accountability and transparency, reducing corruption. A less-powerful but still-significant variable is the dependence of the country on exports of energy—in a few years, and in the aftermath of the Arab Spring beginning in 2011, this term may drop out of cross-sectional analyses of change in governance capacity but will still probably remain very important for those countries with low levels of development and inclusion. (We find that the same drivers work well (an R-squared of 0.62) for the IFs economic freedom variable, based on the Fraser Institute/Economic Freedom Network measure.) A multiplier for scenario analysis is the only exogenous element added to the basic formulation.

$$GOVCORRUPT_{r,t} = \left(1.576 + 0.1133 * GDPPCP_{r,t} + 2.270 * GEM_{t,r} + 0.02779 * DEMOCPOLITY_{r,t} - 0.04566 * \left(ENX_{r,t} * \frac{ENPRI_{r,t}}{GDP_{r,t}}\right)\right) * \boldsymbol{govcorruptm}_{r,t}$$

where

GOVCORRUPT= the Transparency International corruption perception index (for which higher values are more transparent or less corrupt)
GDPPCP=GDP per capita at purchasing power parity in thousand dollars
GEM=Gender Empowerment Measure (values below 1 indicate female disadvantage)
DEMOCPOLITY=Polity's 20-point scale of democracy; inverse relationship
ENX=energy exports in physical terms (billion barrels of oil equivalent)
ENPRI=energy price per barrel
GDP=gross domestic product in billion constant 2000 dollars (market prices)
govcorruptm=an exogenous multiplier for scenario analysis
R-squared in 2010 = 0.75

We compute an additive adjustment term (not shown in the equation) on top of the basic formulation in the base year to capture any difference between the value anticipated in the formulation and the value from data. In most of our formulations we use additive or multiplicative terms in this manner, and the adjustment term introduces the impact of other variables not in the statistically estimated equation (such as historical path dependencies and cultural differences). The additive adjustment term gradually converges to zero over time in our forecasts. The logic behind such convergence is twofold: first, many differences from initial anticipated values are the result of transient factors and even data errors; second, ongoing global processes tend to lead to a convergence of patterns across countries.

There is every reason to believe that the presence of domestic conflict will reduce governmental capacity, including leading to lower levels of transparency (higher corruption). In fact, the inverse relationship between the IFs internal war variable (SFINTLWARALL) and transparency is strong. Even when added to the full equation above it remains quite strong (a T-score of -1.97). Because conflict tends to be quite variable over time, however, we undertook more analysis rather than simply adding conflict to the equation for corruption. Specifically, we experimented with different coefficients in analysis across the historical period (1960-2010). In doing so, we reinforced the result of the pure statistical analysis that a movement from 0 (no conflict) to 1 (conflict) appears to increase corruption (to lower the TI measure) by 0.6 points. We algorithmically overlaid this relationship on the basic equation above.

There are times when the user will wish to introduce normatively controlled target values for corruption. One approach is use of the "brute force" multiplier on corruption (***govcorruptm***). A second approach involves the specification of target values relative to a function of the key drivers estimated cross-sectionally across countries. This second approach allows, for instance, the specification of a target level 1 or 2 standard errors (SE) above the level expected of a country given those drivers. The SE target parameter is ***govcorruptsetar*** and the ***govcorruptseyrtar*** carries the years to achieve the target. Relevant to the discussion below, there are similar control parameters for regulatory quality (***govregqualsetar*** and ***govreqqualseyrtar***) and for effectiveness (***goveffectsetar*** and ***goveffectseyrtar***), but not for economic freedom.

Looking beyond the corruption/transparency measure of Transparency International, IFs also forecasts a number of capacity-related variables from the World Bank's World Governance Indicators project (Kaufmann, Kraay, and Mastruzzi 2010) that we did not use to define the capacity dimension, but that are still of significant interest (used, for instance, in forward linkages to the building of infrastructure). These include the quality of government regulation and government effectiveness. The approaches are identical to those used for corruption and involve the same drivers. The R-squared values are again high (0.74 and 0.72, respectively).

$$GOVREGQUAL_{r,t} = (-1.018 + 0.726 * \ln(GDPPCP_{r,t}) + 0.2085 * EDYRSAG15_{r,t} + 2.5 * \boldsymbol{govregqualm}_{r,t}$$

where

GOVREGQUAL=government regulatory quality using the World Bank WGI scale, shifting it 2.5 points so that it runs from 0-5 instead of from -2.5 to 2.5
GDPPCP=GDP per capita at purchasing power parity
EDYRSAG15=average years of education for adults aged 15 or older
govregqualm=an exogenous multiplier for the model user

$$GOVEFFECT_{r,t} = (-1.1029 + 0.08 * \ln(GDPPCP_{r,t}) + 0.21205 * EDYRSAG15_{r,t} + 2.5 * \boldsymbol{goveffectm}_{r,t}$$

where

GOVEFFECT=government effectiveness using the World Bank WGI scale, shifting it 2.5 points so that it runs from 0-5 instead of from -2.5 to 2.5
GDPPCP=GDP per capita at purchasing power parity
EDYRSAG15=average years of education for adults aged 15 or older
goveffectm=an exogenous multiplier for the model user

We have also computed multivariate functions (using GDP per capita and education as drivers) for the other four WGI measures, voice and accountability, political stability, corruption, and rule of law. But we have not yet added them to IFs.

Turning to policy orientations, we compute an economic freedom variable based on the measures of the Economic Freedom Institute (with leadership from the Fraser Institute; see Gwartney and Lawson with Samida, 2000):

$$ECONFREE_{r,t} = \left(5.4097 + 0.5971 \ln(GDPPCP_{r,t})\right) * \boldsymbol{econfreem}_{r,t}$$

where

ECONFREE= economic freedom using the Fraser Institute/Economic Freedom Network freedom indicator (higher values are freer)
GDPPCP=GDP per capita at purchasing power parity
econfreem=an exogenous multiplier for the model user
R-squared = .5038

3.3 The Inclusion Dimension

Inclusion has many elements that reach beyond democratization or regime type and gender empowerment. For reasons including conceptual clarity, data availability and parsimony, we limit our forecasting to those two elements.

3.3.1 Equations: Regime type

As with capacity, the forecasting of regime type in IFs has multiple elements: (1) a basic statistical formulation; (2) a recognition of country-specific differences (tied in part to path dependencies); and (3) algorithmic specification of a number of additional factors, including global waves and neighborhood effects.

A look at the historical patterns since 1960 of democratization across global regions shows a substantial almost global increase in democracy levels in the late 1970s and 1980s. That suggests reasons that a multi-element and potentially algorithmic forecasting formulation can be useful. Most analyses of democratization place much emphasis on a developmental variable such as GDP per capita. Note, for instance, that the general upward movement of democracy across most developing regions could be forecast with a basic formulation tied to the traditionally-identified development drivers of democracy, including income and education increase. Again, however, this historical pattern, with a clear dip in the early years of the post-1960 period and an accelerated advance in the later decades is consistent with a global wave that a formulation tied only to quite steadily growing long-term developmental variables could not generate. Further, a formulation tied only to such drivers would be unlikely to generate initial conditions for 1960 or 2010 consistent with the actual history, because country and regional values in those years also reflect historical path dependencies.

In building an initial, statistically-based formulation, we looked, as usual, at the power of two highly-correlated long-term development variables (notably GDP per capita and average education years attained by adults). The better broad developmental driving variable proved to be years of adults' education. With additional exploration, however, we found a slight further advantage for the Gender Empowerment Measure, and so replaced the education variable with the GEM (which is, itself, strongly influenced by adults' education). On top of that we found the size of the youth bulge (YTHBULGE) and extent of dependence on energy exports (ENX times the price ENPRI) as a share of GDP to be quite useful (see the discussions in these variables in Chapter 3 of Hughes et al. 2014).

In the equation below, the basic IFs formulation, all terms are significant with T-scores above 2.0 in absolute terms. In earlier work we also explored a linkage to the survival/self-expression dimension of the World Value Survey, but have found that other development variables statistically force it out of the relationship.

$$DEMOCPOLITYBase_{r,t} = \left(13.4 + 11.4 * GEM_{r,t} - 9.73 * YTHBULGE_{r,t} - 0.232 * \left(ENX_{r,t} * \frac{ENPRI_{r,t}}{GDP_{r,t}}\right)\right) * \boldsymbol{democm}_{r,t}$$

where

DEMOCPOLITYBase=basic or initial democracy using the Polity scale (in our case a combined 20-point scale built from historical democracy and autocracy series)
GEM=Gender Empowerment Measure (values below 1 indicate female disadvantage)
YTHBULGE=the youth bulge, the population aged 15–29 as a portion of the entire adult population
ENX=energy exports in physical terms (billion barrels of oil equivalent)
ENPRI=energy price per barrel
GDP=gross domestic product in billion constant 2000 dollars, market prices
democm=an exogenous multiplier for scenario analysis
r=country (geographic region in IFs terminology)
R-squared in 2010 = 0.41

The initial conditions of democracy in countries carry a considerable amount of idiosyncratic, country-specific influence, much of which can be expected to erode over time. Therefore a revised base level is computed that converges over time from the base component with the empirical initial condition built in to the value expected purely on the base of the analytic formulation. The user can control the rate of convergence with a parameter that specifies the years over which convergence occurs (***polconv***) and, in fact, basically shut off convergence by sitting the years very high.

$$DEMOCPOLITYBaseRev_{r,t} = ConvergeOverTime(DEMOCPOLITYBase_{r,t}, DEMOCEXP_{r,t}, \boldsymbol{polconv}$$

The endogenous movement of this basic calculation can also be overridden by the users via the specification of a target value for democracy some number of standard errors (***democpolitysetar***) above or below the cross-sectional estimation of the formulation and the movement of the basic value to that target over a specified number of years (***democpolityseyrtar***). Such targeting of important variables is done in an algorithm described elsewhere.

Additionally we built structures, largely algorithmic, that allow forecasting with waves of democratization influenced by the impetus provided by systemic leadership, computing the magnitude of the global wave effect for all countries (DemGlobalEffects). Those depend on the amplitude of waves (DEMOCWAVE) relative to their initial condition and on a multiplier (EffectMul) that translates the amplitude into effects on states in the system. Because democracy and democratic wave literature often suggests that the countries in the middle of the democracy range are most susceptible to movements in the level of democracy, the analytic function enhances the affect in the middle range and dampens it at the high and low ends.

The democratic wave amplitude is a level that shifts over time (DemocWaveShift) with a normal maximum amplitude (***democwvmax***) and wave length (***democwvlen***), both specified exogenously, with the wave shift controlled by a endogenous parameter of wave direction that shifts with the wave length (DEMOCWVDIR). The normal wave amplitude can be affected also by impetus towards or away from democracy by a systemic leader (DemocImpLead), assumed to be the exogenously specified impetus from the United States (***democimpus***) compared to the normal impetus level from the U.S. (***democimpusn***) and the net impetus from other countries/forces (***democimpoth***).

$$DEMOCWAVE_t = DEMOCWAVE_{t-1} + DemocimpLead + \boldsymbol{democimpoth} + DemocWaveShift$$

where

$$DemocimpLead = \frac{(\boldsymbol{democimpus} - \boldsymbol{democimpusn}) * \boldsymbol{eldemocimp}}{\boldsymbol{democwvlen}}$$

$$DemocWaveShift = \frac{\boldsymbol{democwvmax}}{\boldsymbol{democwvlen}} * DEMOCWVDIR$$

Our historical analysis suggests the waves could have magnitudes (trough to peak) of as much as 6 points on the 20-point Polity scale of combined democracy and autocracy, although we found in historical analysis that downward shifts tend to be only one-third as great as upward movements. We found that the swings appear greatest in the anocracies, and that countries with higher incomes appear unaffected by them. We have structured and then "tuned" the general IFs representation of such effects so that the representation appears generally consistent with behavior over our 1960–2010 period of historical analysis. Nonetheless, we have no basis for forecasting the impetus that the U.S. or other systemic leadership might provide in the future, and we therefore set parameters for forecasting so that the effect is neutralized unless model users decide to introduce such an impetus on a scenario basis. The parameter for the U.S. impetus (***democimpus***) is set equal to the parameter for "normal" impetus (***democimpusn***), and that for other sources of impetus (***democimpoth***) is set to 0.

On top of the country-specific calculation and the global wave effect sits an (optional) regional or swing state effect calculation (SwingEffects), turned on by setting the swing states parameter (***swseffects***) to 1. The countries set as default neighborhood leaders are Brazil, Indonesia, Mexico, Nigeria, Pakistan, Russian Federation, South Africa, Turkey, and the Ukraine.

The swing effects term has three components. The first is a world effect, whereby the democracy level in any given state (the "swingee") is affected by the world average level, with a parameter of impact (**swingstdem**) and a time adjustment (**timeadj**). The second is a regionally powerful state factor, the regional "swinger" effect, with similar parameters. The third is a swing effect based on the average level of democracy in the region (RgDemoc). The size of the swing effects is further constrained algorithmically by an external parameter (***swseffmax***), not shown in the equation below.

$$SwingEffects_{r,t} = timeadj * \boldsymbol{swingstsdem}_{r=Swinger,p=1} * \left(WDemoc_{t-1} - DEMOCPOLITY_{r=Swingee,t-1}\right) + timadj * \boldsymbol{swingstdem}_{\boldsymbol{r=Swinger,p=2}} * \left(DEMOCPOLITY_{r=Swinger,t-1} - DEMOCPOLITY_{r=Swingee,t-1}\right) + timadj * \boldsymbol{swingstdem}_{\boldsymbol{r=Swinger,p=3}} * \left(RgDemoc - DEMOCPOLITY_{r=Swingee,t-1}\right)$$

where

timeadj=.2

$$WDemoc_{t-1} = \frac{\sum^{R} DEMOCPOLITY_{r,t-1}}{R}$$

else

$$SwingEffects_{r,t} = 0$$

David Epstein of Columbia University did extensive estimation of the parameters (the adjustment parameter on each term is 0.2). Unfortunately, the levels of significance were inconsistent across swing states and regions. Moreover, the term with the largest impact is the global term, already represented somewhat redundantly in the democracy wave effects. Hence, these swing effects are normally turned off (the ***sweffects*** parameter is 0 in the Base Case scenario) and are available for optional use.

Further, we anticipated and explored for an impact of internal war on democratization, as discussed in some of the literature. Although there is a cross-sectional relationship, it is weak. Further, when the variable is added to a formulation with a long-term driver such as GEM, it actually reverses sign (more war is associated with greater democracy) and the significance drops further. One of the analytical difficulties is that a number of countries, like India and Israel, are both democratic and prone to internal conflict. Internal conflict conceptualization and measurement probably need refinement to take into consideration the actual threat level that internal war poses to regimes. We have explored the relationship using the PITF data on conflict magnitude rather than simply event occurrence and have found similar difficulties. Given our analysis, we have not built a relationship from intrastate conflict into our forecasting of democracy.

Thus the final equation for democracy adds the global wave effects and the swing effects (both turned off in the base case) to the revised basic calculation of it.

$$DEMOCPOLITY_{r,t} = DEMOCPOLITYBaseRev_{r,t} + SwingEffects_{r,t} + DemGlobalEffects_{r,t}$$

IFs has the capability of doing an historical simulation between 1960 and 2010 so that we can compare with data. We undertook such an analysis using the basic democratization formulation and wave-based modifications to it described above. Although we introduced an historical wave exogenously, no other interventions were made to affect the course of the forecasts for level of democracy. The R-squared in a cross-sectional analysis comparing the IFs regional forecast for 2010 against Polity data was 0.69 and the value across the entire time period was 0.78. That provides a false sense of the accuracy of our historical forecasts, however. At the country level the R-squared in 2010 was only 0.09 and the value over the entire 50-year period was 0.37. IFs expected higher values than proved to be the case for countries including Qatar, Singapore, Cuba, Kuwait, and Belarus. IFs expected lower values than Polity data show for countries including Nigeria, Ethiopia, Bangladesh and Moldova.

Most significantly, IFs failed to anticipate the large rise in democracy in Africa in the 1990s. More generally, however strong our basic formulations for forecasting democracy may become, they are unlikely to foresee the timing of transitions toward or away from democracy. One approach to helping with that is to try to assess the pressures or unmet demand for democracy. As a small step in that direction, and using the concept of democratic deficit that Chapter 2 introduced, the model also computes an expected democracy variable (DEMOCEXP) directly from the equation above without exogenous multiplier or convergence to the function. This is useful for those who wish to see the magnitude of a country's democratic deficit or surplus by comparing DEMOC with DEMOCEXP. In fact, in advance of the Arab spring of 2011, IFs analysis (Cilliers, Hughes, and Moyer 2011) had identified the Middle East and North Africa as having exceptionally large democratic deficits.

Although we use the Polity democracy measure as our central indicator of regime type (including its use in the more general measure of governance inclusiveness) IFs also calculates in a simpler fashion a FREEDOM measure (combining the Freedom House political rights and civil liberties scales into one scale running from least to most free). Specifically, the drivers are GDP per capita and adult educational attainment, our two standard long-term development drivers. Interestingly, the R-squared between the democracy and freedom measures in 2010 (using data from both projects) is 0.686 and that in 2060 (using forecasts of IFs for both measures) is a nearly identical 0.689. This suggests that the long-term driver variables in our formulations are doing a quite good job of representing the similarities and differences in the two measures.

$$FREEDOM_{r,t} = \left(6.3718 + 1.6659 * \ln\left(GDPPCP_{r,t}\right) + 0.1293 * EDYRSAG15_{r,t}\right) * \boldsymbol{freedomm}_{r,t}$$

where

FREEDOM=freedom using 14-point Freedom House scale (PL and CL summed), inverted so that higher is more free
GDPPCP=GDP per capita at purchasing power parity in thousand dollars
EDYRSAG15=average years of education for adults aged 15 or older
freedomm=an exogenous multiplier for the model user
R-squared=0.402

Although IFs uses the Polity measure of democracy (DEMOCPOLITY) as its main measure of more formal, electoral inclusion, Freedom House's freedom measure (FREEDOM) is a logical alternative and the second of that measure's sub-dimensions, civil liberties, is a more inclusive measure. We therefore compute it also, using again GDP per capita and educational years (of all adults, not just females) as drivers. And there is a brute force multiplier for it also (***freedomm***). There is no SE targeting mechanism in place for the freedom variable.

3.3.2 Equations: Gender empowerment

It is not surprising that a measure of women's inclusion, such as the Gender Empowerment Measure (GEM) of the UNDP, should correlate highly with GDP per capita or years of formal education of adult women. As we have seen, income and education are closely correlated and one or the other is almost invariably a key driver in our forecasts of change in governance. It is perhaps more surprising, in the formulation below, that together they both make statistically significant contributions to GEM. The relationship between GDP per capita and the GEM has shifted over time—the advance of global education, even in countries with low levels of income, helps explain that shift and almost certainly helps account for the independent contribution of education to higher levels of female empowerment. Interestingly, women's education does not differ in its statistical contribution from that of men; we nonetheless use that of women in our formulation.

One might expect a strong relationship between total fertility rate and GEM as women who bear fewer children rise in other ways in society. There is, in fact, a strong correlation. Interestingly, however, a stronger one inversely relates the size of the youth bulge to the GEM. The IFs formulation is:

$$GEM_{r,t} = \left(0.4429 + 0.003401 * GDPPCP_{r,t} + 0.0271 * EDYRSAG15_{r,g=f,t} - 0.506 * YTHBULGE_{r,t}\right) * \boldsymbol{gemm}_{r,t}$$

where

GEM=UNDP Gender Empowerment Measure
GDPPCP=GDP per capita at purchasing power parity in thousand dollars
EDYRSAG15=average years of education for females age 15 or older
YTHBULGE=youth bulge, the population aged 15–29 as a portion of the entire adult population
gemm=an exogenous multiplier for scenario analysis
R-squared in 2010=0.66

We experimented with a variation on the above formulation in which GDP per capita enters in a logged term, and found nearly as high an R-squared (0.64). However, a problem in longer-term forecasting with such a variation is that the saturation of the log of GDP per capita nearly stops growth in GEM for more developed countries, often well below parity for women.

A user can control the progression of gender empowerment with a simple multiplier (***gemm***) or via setting a target value for it movement to some number of standard errors above or below a cross-sectionally estimated function (***gemsetar***) across a set number of years (***gemseyrtar***).

3.4 Governance indices

IFs represents three dimensions of governance (security, capacity, and inclusion) and uses two sub-dimensions for each. Just as the dimensions themselves show considerable conceptual independence, the sub-dimensions tend not to be highly correlated.

Thus there is value in creating an index for each of the three governance dimensions that integrates the two variables representing them as well as an overall index. We have taken the typical basic approach to index construction when there is no clear external referent against which to judge the validity of the resultant index; that is, we have scaled each variable from 0 to 1 and averaged the two variables that make up each dimension. The resultant indices, GOVINDSECUR, GOVINDCAPAC, and GOVINDINCLUS, each have a global average value near 0.5, but the distribution of countries across the component measures varies; for instance, because the intrastate conflict variable of the security index exhibits a power-law distribution, the global average of the security measure is slightly higher than that of the other two indices. The security index uses 1.0 minus the average of the probability of intrastate war and the IFs performance risk index—the relative infrequency of intrastate war causes many states to cluster near 1.0 in the former formulation.

In computing the index for governance capacity, we do not attribute increased capacity to countries when the revenue to GDP ratio rises above 0.45. Migdal (1988: 281) and Joshi (2011) suggest that the appropriate upper limit is 0.30, but their focus is on central government; our own analysis suggests that local government can on average for high-income countries add another 0.15 (15 percent of GDP) to that ratio.

Finally, we compute an overall governance index (GOVINDTOTAL) as the simple average across the three dimensions. Just as the rankings of countries on the three dimensional indices provide some face or subjective validity to the indices, the rankings on the combined index likely correspond to the general perceptions that most analysts have.

4. Performance Risk Analysis Form

IFs includes a Performance Risk Index (GOVRISK) and an associated display to facilitate Performance and Risk Analysis, for instance by changing the weight of variables in the index. The design is intended primarily for analysis of single countries, but the form allows also consideration of country groups. It also facilitates comparison of alternative scenarios, mainly to display single country characteristics, but with the ability to switch to groups, compare different scenarios, different countries or groups.

The overall risk form and index build on nine categories of variables:

> The first three categories correspond to the three dimensions of governance in IFs but do not use precisely the same sub-dimensional variables (in part because the performance risk index is itself a sub-dimension of security and that would create a circularity, but partly also because the risk index is meant to be a dynamic assessment vehicle that allows users to tailor the analysis to their own understanding of what constitutes risk. The three governance dimensions and variables used in the index are: security (instability and internal war); capacity (corruption and effectiveness); and inclusion (democracy, freedom, and the gender empowerment measure).
>
> The next three categories in the index are associated with drivers that many analysts have associated with country risk. The categories and associated variables are: population (youth bulge, elderly bulge [with a 0-weighting for the developing country oriented analysis of interest to most form users], and urbanization rate); environment (water use as a portion of renewable supplies and climate change); international (power transition).
>
> The final three categories in the index represent specific arenas of government and societal performance. Again with associated variables they are: the economy (poverty, inequality, resource export dependence, and per capita GDP growth rate); health (infant mortality, life expectancy, malnutrition and HIV prevalence); and education (primary net enrollment and years of formal education of adults).

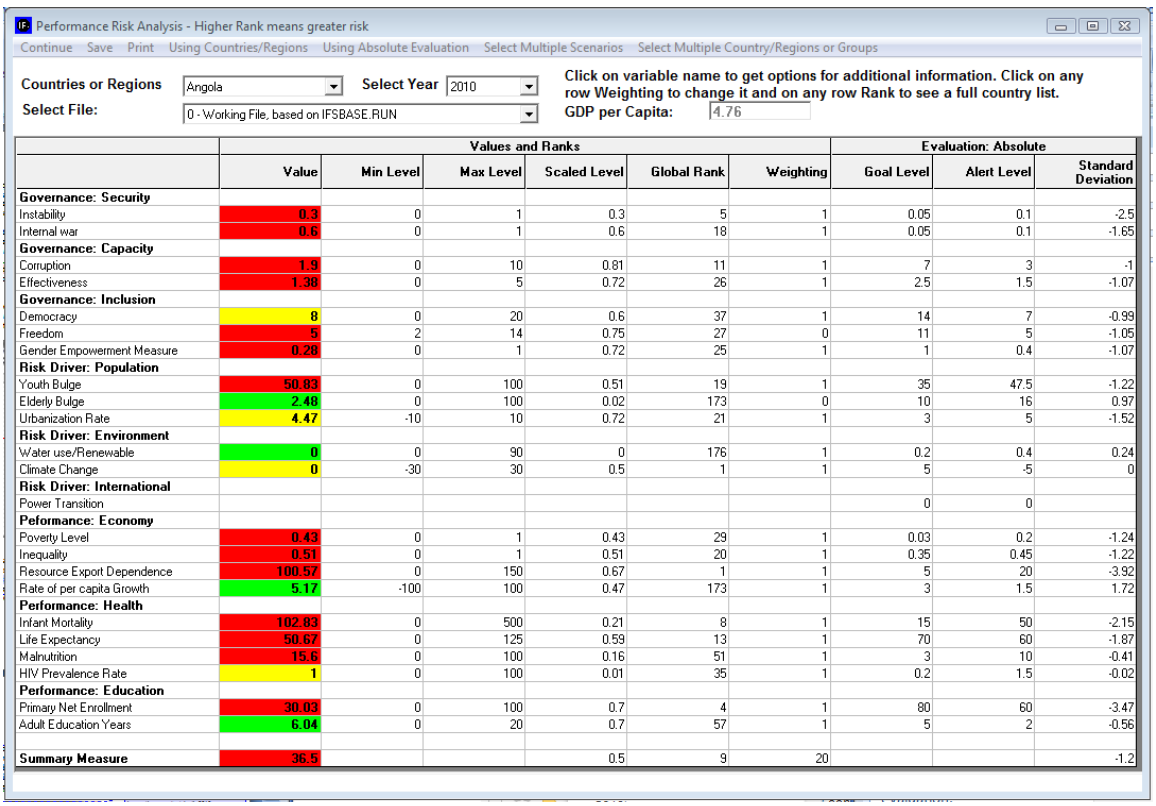
Information about each country across variables is organized into two clusters of columns. The first cluster provides information about values and ranks:

> The Value column is the actual IFs forecast for each specific variable (for instance, the life expectancy for Angola in 2010 reflects data and is near 50.
>
> The Min Level and Max Level columns indicate the overall range over which each variable varies across counties and time. These levels are constant across years and countries. They are used in computing the Scaled Levels.
>
> The Scaled Level column uses the minimum and maximum levels to scale values for each country from 0 to 1. The scaling takes into account the valence of each

variable (that is, infant mortality is bad and life expectancy is good). The Summary Measure in the last row of this column is a weighted average of the scaled levels on each variable; this computation is saved as the GOVRISK variable in our forecast files for each country and each year

The Global Rank column indicates how each country ranks among all countries on each variable. The Summary Measure in the last row at the bottom of the column uses a weighted average of the ranks for each variable to compute the ordinal position of the country when sorting across all countries. Lower Ranks indicate higher risk levels (or worst performance). Clicking on any cell in this column provides a pop-up option for showing the rank of all countries on specific variables or the Summary Measure.

The Weighting column determines how the variables are combined in computing the summary Scaled Levels and Global Ranks of a country. Clicking on any cell in that column allows the user to change the weight for the associated variable.



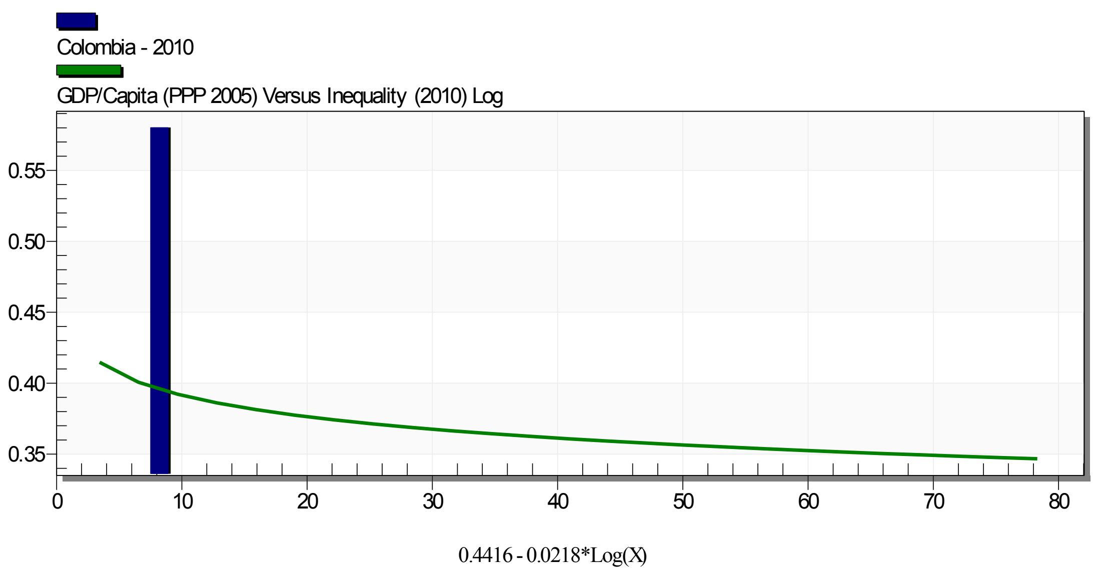
	Values and Ranks						Evaluation: Absolute		
	Value	Min Level	Max Level	Scaled Level	Global Rank	Weighting	Goal Level	Alert Level	Standard Deviation
Governance: Security									
Instability	0.3	0	1	0.3	5	1	0.05	0.1	-2.5
Internal war	0.6	0	1	0.6	18	1	0.05	0.1	-1.65
Governance: Capacity									
Corruption	1.9	0	10	0.81	11	1	7	3	-1
Effectiveness	1.38	0	5	0.72	26	1	2.5	1.5	-1.07
Governance: Inclusion									
Democracy	8	0	20	0.6	37	1	14	7	-0.99
Freedom	5	2	14	0.75	27	0	11	5	-1.05
Gender Empowerment Measure	0.28	0	1	0.72	25	1	1	0.4	-1.07
Risk Driver: Population									
Youth Bulge	50.83	0	100	0.51	19	1	35	47.5	-1.22
Elderly Bulge	2.48	0	100	0.02	173	0	10	16	0.97
Urbanization Rate	4.47	-10	10	0.72	21	1	3	5	-1.52
Risk Driver: Environment									
Water use/Renewable	0	0	90	0	176	1	0.2	0.4	0.24
Climate Change	0	-30	30	0.5	1	1	5	-5	0
Risk Driver: International									
Power Transition							0	0	
Peformance: Economy									
Poverty Level	0.43	0	1	0.43	29	1	0.03	0.2	-1.24
Inequality	0.51	0	1	0.51	20	1	0.35	0.45	-1.22
Resource Export Dependence	100.57	0	150	0.67	1	1	5	20	-3.92
Rate of per capita Growth	5.17	-100	100	0.47	173	1	3	1.5	1.72
Performance: Health									
Infant Mortality	102.83	0	500	0.21	8	1	15	50	-2.15
Life Expectancy	50.67	0	125	0.59	13	1	70	60	-1.87
Malnutrition	15.6	0	100	0.16	51	1	3	10	-0.41
HIV Prevalence Rate	1	0	100	0.01	35	1	0.2	1.5	-0.02
Performance: Education									
Primary Net Enrollment	30.03	0	100	0.7	4	1	80	60	-3.47
Adult Education Years	6.04	0	20	0.7	57	1	5	2	-0.56
Summary Measure	36.5			0.5	9	20			-1.2

The color for each variable in the Value column indicates the position of the value relative to the alert and goal levels. Values between the alert and goal levels are yellow, values on undesirable side of the alert level (depending on the valence of the variable) are red, and values on the desirable side of the goal level are green. For the Summary Measure the color coding is a bit different: .red indicates the 40 countries performing least well in the aggregate (numbers 1 through 40 in the

Global Rank column), green shows the 40 countries doing best; yellow indicates all other countries.

The second cluster of columns provides evaluation information. Evaluation can be either absolute or relative to income (actually GDP per capita), as determined by the menu option that toggles between those two forms (the column cluster heading changes also with the toggle value). The default approach is absolute evaluation, setting up comparison of countries and evaluation of their performance independently of their development level.

The relative or income-adjusted evaluation approach takes into account the GDP per capita of the country and has a "benchmarking" character. That is, evaluation of countries takes into account the GDP per capita at PPP of countries, expecting different performance at difference levels. The expectations upon which relative evaluation occurs are related to cross-sectionally estimated relationships of the Values for each variable across all countries. For instance, the cross-sectional relationship for Inequality using the Gini index (on the Y-axis) as a function of GDP per capita at PPP (on the X-axis) is the following:



Higher values indicate poorer performance or more risk and Colombia is shown on this figure as having a considerably higher than expected level of inequality. We would expect Colombia to be evaluated poorly on this variable both in absolute terms and relative to its income level.

The columns in the Evaluation cluster are:

Goal and Alert Levels will change depending on the evaluation method. When using absolute evaluation, the level values will not vary across countries (we have set absolute Goal and Alert Levels exogenously based on our own analysis across countries). When using income-adjusted or relative evaluation, the values will be recomputed based on the GDP per capita level of a specific country in a given year. Specifically, in income-adjusted evaluation the Goal Levels are generally set at the value of the function for the GDP per capita of the country in the year being analyzed. The Alert Levels are generally 1 or 2 standard errors below or above the value of the function;[1] below or above depends on whether higher or lower values indicate better performance.

The third evaluation column will show the Standard Deviation of Values for all countries around the global mean in the case of Absolute Evaluation and will show the Standard Error of all countries around the function in the case of income-adjusted evaluation.

Useful information can be obtained beyond that apparent in the table by clicking on particular cells:

Cells within the Value, Scaled Level, and Standard Deviation/Standard Error columns can be displayed across time by clicking on them and selecting the pop-up menu option.

You can generate a rank-ordered list of countries based on a given variable by clicking on a cell in the Global Rank column and selecting the pop-up menu option.

Clicking on a cell in the Value column and selecting the option "Display All Years and All Countries Ranked" produces a table of all values for all countries across time with countries ranked left-to-right from riskier to less risky values in the selected year.

Clicking on any variable name provides a pop-up menu with useful information related to evaluation. The Cross-Sectional Relationship option on that pop-up shows the function for the variable and selected country's position relative to the function. The Provide Information option provides information on the Goal and Alert Levels for any specific variable; it also gives a set of information explaining the variable and bibliographic references when available. The Show Count option will display the number of countries in alert level, moderate risk or not at risk using absolute evaluation only.

Additional menu options exist on the form:

On the form called up by Select Multiple Scenarios holding down the Ctrl key allows selecting multiple scenarios. Once selected they can be displayed

---

[1] There is subjectivity in this. We mostly use 2 standard errors (11 times); next we use 1 SE (9 times: Elderly Bulge, Poverty Level, Inequality, Rate of per capita Growth, Infant Mortality, Life Expectancy, Malnutrition, Adult Education Years and Urbanization Rate); then use 0.5 twice: Democracy and Freedom,' and finally we use 0.2 for GEM.

simultaneously, for instance by clicking on a cell in the Value column and selecting the pop-up option to Show Over Time.

On the form called up by Select Multiple Country/Regions or Groups holding down the Ctrl key allows selecting multiple countries or groups; again these can be displayed, for instance, by clicking on a cell in the Value column and requesting Show Over Time.

Using Countries/Regions is the default menu option geographically, but it toggles with click to Using Groups. Groups are displayed with ranks that weight country members by population (the group aggregations of Values use varying weighting variables; for instance, the climate change variable uses GDP).

5. The Broader Socio-Cultural Context

Governance is rooted in a much broader socio-cultural context including the condition of individuals within society and the values and beliefs they hold. Much of that context is spread across the various modules of IFs. For instance, literacy and educational attainment are determined in the education model. Income levels and income distribution are in the economic model. Here we focus primarily on the aggregation of those into the summary HDI indicator and the expression of them in selected indicators of values and cultural orientations.

5.1 Human Development

Human development measures invariable look to such variables as life expectancy, literacy or other indication of educational attainment, income, etc. These variables are computed in other IFs models, but provide a basis for socio-political analysis.

Literacy is a variable fundamentally tied to educational attainment. In IFs it changes from the initial level for a country because of a multiplier *(*LITM).

$$LIT_r = \boldsymbol{LIT}_{r,t=1} * LITM_r$$

The function upon which the literacy multiplier is based represents the cross-sectional relationship globally between the percentage of adults who have completed a primary education (EDPRIPER from the education model) and literacy rate (LIT). Rather than imposing the typical literacy rate from this function (and thereby being inconsistent with initial empirical values), the literacy multiplier is the ratio of typical literacy given future adult primary completion percentage to the normal literacy level at initial primary completion percentage.

$$LITM = \frac{AnalFunc(EDPRIPER)}{AnalFunc(\boldsymbol{EDPRIPER}_{t=1})}$$

At one time the IFs system represented an aggregate view of life conditions within a society by using the Physical Quality of Life Index (PQLI) of the Overseas Development Council (ODC, 1977: 147#154). This measure averaged literacy, life expectancy, and infant mortality, first normalizing each indicator so that it ranges from zero to 100.

The United Nations Development Program's human development index (HDI) has fully supplanted that early measure in the development literature. The HDI began as is a simple average of three sub-indices for life expectancy, education, and GDP per capita (using purchasing power parity).. The GDP per capita index is a logged form that runs from a minimum of 100 to a maximum of $40,000 per capita. The original measure in IFs differs slightly from the original HDI version, because it does not put educational enrollment rates into a broader educational index with literacy.

$$HDI_r = \frac{LifeExpInd_r + LitInd + GDPInd}{3}$$

where

$$LifeExpInd = \frac{LIFEEXP_r - LIFEXPMIN}{LIFEXPMAX - LIFEXPMIN}$$

$$LitInd = LIT_r/100$$

$$GDPInd = \frac{Log(GDPPCP_r * 1000) - Log(100)}{Log(40000) - Log(100)}$$

Although the HDI is a wonderful measure for looking at past and current life conditions, it has some limitations when looking at the longer-term future. Specifically, the fixed upper limits for life expectancy and GDP per capita are likely to be exceeded by many countries before the end of the 21st century. IFs therefore introduced a floating version of the HDI, in which the maximums for those two index components are calculated from the maximum performance of any state in the system in each forecast year.

$$HDIFLOAT_r = \frac{LifeExpInd_r + LitInd + GDPInd}{3}$$

where

$$LifeExpInd = \frac{LIFEEXP_r - LIFEXPMIN}{HDILIFEMAXFLOAT - LIFEXPMIN}$$

$$LitInd = LIT_r/100$$

$$GDPInd = \frac{Log(GDPPCP_r * 1000) - Log(100)}{Log(GDPPCMAX) - Log(100)}$$

The floating measure, in turn, has some limitations because it introduces relative attainment into the equation rather than absolute attainment. IFs therefore developed still a third version of the original HDI, one that allows the users to specify probable upper limits for life expectancy and GDPPC in the twenty-first century. Those enter into a fixed calculation of which the normal HDI could be considered a special case.

$$HDI21stFIX_r = \frac{LifeExpInd_r + LitInd + GDPInd}{3}$$

where

$$HDILIFEMAX21 = \boldsymbol{hdilifemaxf}$$

$$LifeExpInd = \frac{LIFEEXP_r - LIFEXPMIN}{HDILIFEMAX21 - LIFEXPMIN}$$

$$LitInd = LIT_r/100$$

$$LogGDPPCP21 = Log(\boldsymbol{hdigdppcmax} * 1000)$$

$$GDPInd = \frac{Log(GDPPCP_r * 1000) - Log(100)}{LogGDPPCP21 - Log(100)}$$

In 2010 the Human Development Report Office of the UNDP changed its computation of HDI and the IFs model followed suit with a new version named HDINEW. That measure moved to a different aggregation of the components, one that uses a geometric mean of the component elements. It further changed the computation by creating a revised education index that is a geometric mean of two subcomponents, mean years of schooling of adults (EDYRSAG25) and expected years of schooling of school entrants (EDYRSSLE). It continues to use life expectancy (LIFEXP) and gross national income per capita at PPP, for which IFs substitutes GDP per capita at PPP (GDPPCP).

$$HDI_r = (LifeExpInd)^{1/3} * (EdInd)^{1/3} * (GDPInd)^{1/3}$$

where

$$LifeExpInd = \frac{LIFEEXP_r - LIFEXPMIN}{LIFEXPMAX - LIFEXPMIN}$$

$$EdInd = (EDYRSSLEIND)^{1/2} * (EDYRSAG25IND)^{1/2}$$

$$GDPInd = \frac{Log(GDPPCP_r * 1000) - Log(100)}{Log(40000) - Log(100)}$$

where

$$EDYRSSLEIND = EDYRSSLE/EDYRSSLEMAX$$

$$EDYRSAG25IND = EDYRSAG25/EDYRSAG25MAX$$

We further compute several global indicators including a world life expectancy (WLIFE) and a world literacy rate (WLIT).

$$WLIFE = \frac{\sum^R LIFEXP_r * POP_r}{WPOP}$$

$$WLIT = \frac{\sum^R LIT_r * POP_r}{WPOP}$$

5.2 Roots of Culture: Beliefs and Values

IFs computes change in three cultural dimensions identified by the World Values Survey (Inglehart 1997). Those are dimensions of materialism/post-materialism (MATPOSTR), survival/self-expression (SURVSE), and traditional/secular-rational values

(TRADSRAT). On each dimension the process for calculation is somewhat more complicated than for freedom or gender empowerment, however, because the dynamics for change in the cultural dimensions involves the aging of population cohorts. IFs uses the six population cohorts of the World Values Survey (1= 18-24; 2=25-34; 3=35-44; 4=45-54; 5=55-64; 6=65+). It calculates change in the value orientation of the youngest cohort (c=1) from change in GDP per capita at PPP (GDPPCP), but then maintains that value orientation for the cohort and all others as they age. Analysis of different functional forms led to use of an exponential form with GDP per capita for materialism/postmaterialism and to use of logarithmic forms for the two other cultural dimensions (both of which can take on negative values).

$$MATPOSTR_{r,c=1} = \boldsymbol{MATPOSTR}_{r,c=1,t=1} * \frac{AnalFunc(GDPPCP_r)}{AnalFunc(GDPPCP_{r,t=1})} + \boldsymbol{CultShMP}_{r=cultural} + \boldsymbol{matpostradd}_{r,t}$$

where

$$\boldsymbol{CultShMP}_{\boldsymbol{r=cultural,t}} = F(\boldsymbol{MATPOSTR}_{r,c=1,t=1}, AnalFunc(GDPPCP_{r,t=1})$$

$$SURVSE_{r,c=1} = \boldsymbol{SURVSE}_{r,c=1,t=1} * \frac{AnalFunc(GDPPCP_r)}{AnalFunc(GDPPCP_{r,t=1})} + \boldsymbol{CultShSE}_{r=cultural,t} + \boldsymbol{survseadd}_{r,t}$$

where

$$\boldsymbol{CultShSE}_{r=cultural,t} = F(\boldsymbol{SURVSE}_{\boldsymbol{r,c=1,t=1}}, AnalFunc(GDPPCP_{r,t=1})$$

$$TRADSRAT_{r,c=1} = \boldsymbol{TRADSRAT}_{r,c=1,t=1} * \frac{AnalFunc(GDPPCP_r)}{AnalFunc(GDPPCP_{r,t=1})} + \boldsymbol{CultShTS}_{\boldsymbol{r=cultural,t}} + \boldsymbol{tradsratadd}_{r,t}$$

where

$$\boldsymbol{CultShTS}_{r=cultural,t} = F(\boldsymbol{TRADSRAT}_{\boldsymbol{r,c=1,t=1}}, AnalFunc(GDPPCP_{r,t=1})$$

The user can influence values on each of the cultural dimensions via two parameters. The first is a cultural shift factor (e.g. CultSHMP) that affects all of the IFs countries/regions in a given cultural region as defined by the World Value Survey. Those factors have initial values assigned to them from empirical analysis of how the regions differ on the cultural dimensions (determined by the pre-processor of raw country data in IFs), but the user can change those further, as desired. The second parameter is an additive factor specific to individual IFs countries/regions (e.g. matpostradd). The default values for the additive factors are zero.

Some users of IFs may not wish to assume that aging cohorts carry their value orientations forward in time, but rather want to compute the cultural orientation of cohorts directly from cross-sectional relationships. Those relationships have been calculated for each cohort to make such an approach possible. The parameter (wvsagesw) controls the dynamics associated with the value orientation of cohorts in the model. The standard value for it is 2, which results in the "aging" of value orientations. Any other value for wvsagesw (the WVS aging switch) will result in use of the cohort-specific functions with GDP per capita.

Regardless of which approach to value-change dynamics is used, IFs calculates the value orientation for a total region/country as a population cohort-weighted average.

Although we have explored the forward linkages of value change to other variables, including democracy, the IFs project has not given either the forecasting of value/culture change nor the impacts of it the attention they deserve. This is a great opportunity for creative thinking and modeling in the future.

References

Barro, Robert J. and Jong-Wha Lee. 2001. "International Data on Educational Attainment: Updates and Implications," *Oxford Economic Papers* 53(3): 541-563.

Cilliers, Jakkie, Barry Hughes, and Jonathan Moyer. 2011. *African Futures 2050: The Next 40 Years*. Pretoria, South Africa and Denver, Colorado: Institute for Security Studies and Frederick S. Pardee Center for International Futures.

Correlates of War Project. 2011. "State System Membership List, v2011." Online, http://correlatesofwar.org.

Diamond, Larry. 1992. "Economic Development and Democracy Reconsidered." *American Behavioral Scientist* 35(4/5): 450-499.

Diehl, Paul F., ed. 1999. *A Roadmap to War: Territorial Dimensions of International Conflict*, 1st ed. Nashville: Vanderbilt University Press.

Easton, David. 1965. *A Framework for Political Analysis*. Englewood Cliffs, New Jersey: Prentice-Hall.

Esty, Daniel C., Jack A. Goldstone, Ted Robert Gurr, Barbara Harff, Marc Levy, Geoffrey D. Dabelko, Pamela Surko, and Alan N. Unger. 1998. "State Failure Task Force Report: Phase II Findings." Study Commissioned by the Central Intelligence Agency and George Mason University School of Public Policy. Political Instability Task Force, Arlington VA.

Freedom House, Inc. 2009. *Freedom in the World 2009: The Annual Survey of Political Rights and Civil Liberties*. Washington, DC: Freedom House, Inc.\

Goldstone, Jack A. 2010. "The New Population Bomb" *Foreign Affairs* (January/February): 31-43.

Goldstone, Jack A., Robert H. Bates, David L. Epstein, Ted Robert Gurr, Michael B. Lustik, Monty G. Marshall, Jay Ulfelder, and Mark Woodward. 2010. "A Global Model for Forecasting Political Instability." *American Journal of Political Science* 54(1): 190-208. doi: 10.1111/j.1540-5907.2009.00426.x.

Hughes, Barry B. 2001. "Global Social Transformation: The Sweet Spot, the Steady Slog, and the Systemic Shift." *Economic Development and Cultural Change* 49(2): 423-458. doi: 10.1086/452510.

Hughes, Barry B. 2002. "Threats and Opportunities Analysis," working document prepared for the Strategic Assessments Group, Office of Transnational Issues, Central Intelligence Agency. Available on the IFs project web site at www.ifs.du.edu.

Hughes, Barry B., and Anwar Hossain. 2003. "Long-Term Socio-Economic Modeling: With Universal, Globally-Integrated Social Accounting Matrices (SAMs) in a General Equilibrium Model Structure." Working Paper, University of Denver, Denver, CO. http://www.ifs.du.edu/assets/documents/economyandsamdocument46.pdf

Hughes, Barry B., Devin Joshi, Jonathan Moyer, Timothy Sisk and José Roberto Solórzano. 2014. *Strengthening Governance Globally.* vol. 5, Patterns of Potential Human Progress series. Boulder, CO, and New Delhi, India: Paradigm Publishers and Oxford University Press.

Huntington, Samuel P. 1991. *The Third Wave: Democratization in the Late Twentieth Century*. Norman, OK: University of Oklahoma.

Inglehart, Ronald. 1997. *Modernization and Postmodernization*. Princeton: Princeton University Press.

Joshi, Devin. 2011a. "Good Governance, State Capacity, and the Millennium Development Goals." *Perspectives on Global Development and Technology* 10(2): 339-360. doi: 10.1163/156914911X5824.68.

Kaufmann, Daniel, Aart Kraay, and Massimo Mastruzzi. 2010. "The Worldwide Governance Indicators: Methodology and Analytical Issues." World Bank Policy Research Working Paper no. 5430. World Bank, Washington, DC.

Marshall, Monty G. and Benjamin R. Cole. 2008. "Global Report on Conflict, Governance and State Fragility 2008." *Foreign Policy Bulletin* 18: 3-21. doi: 10.1017/S1052703608000014.

Marshall, Monty G., and Benjamin R. Cole. 2009. "Global Report 2009: Conflict, Governance, and State Fragility." Vienna, VA.: Center for Systemic Peace and Center for Global Policy.

Marshall, Monty G., and Benjamin R. Cole. 2011. "Global Report 2011: Conflict, Governance, and State Fragility." Vienna, VA. Center for Systemic Peace.

Marshall, Monty G., and Keith Jaggers. 2011. "Polity IV Project: Political Regime Characteristics and Transitions 1800-2010." http://www.systemicpeace.org/polity/polity4.htm [accessed December 22 2012]

Mauro, Paolo. 1995. "Corruption and Growth." *The Quarterly Journal of Economics* 110(3) (August): 681-712.

Migdal, Joel. 1988. *Strong Societies and Weak Sates: State-Society Relations and State Capabilities in the Third World*. Princeton: Princeton University Press

Mo, Pak Hung. 2001. "Corruption and Economic Growth." *Journal of Comparative Economics* 29(1) (March): 66-79. doi:10.1006/jcec.2000.1703.

North, Douglass C., John Joseph Wallis, and Barry R. Weingast. 2009. *Violence and Social Orders: A Conceptual Framework for Interpreting Recorded Human History*. Cambridge: Cambridge University Press.

Pierson, Paul. 2004. *Politics in Time: History, Institutions, and Social Analysis*. Princeton, NJ: Princeton University Press.

Rice, Susan E., and Stewart Patrick. 2008. *Index of State Weakness in the Developing World.* Washington, DC: The Brookings Institution.

Shihata, Ibrahim F. I. 1996. "Corruption - A General Review with an Emphasis on the Role of the World Bank." *Dickinson Journal of International Law* 15: 451.

Tanzi, Vito. 1998. "Corruption Around the World: Causes, Consequences, Scope, and Cures." Staff Papers - International Monetary Fund 45(4) (December): 559-594.

Urdal, H. 2004. "The devil in the demographics: the effect of youth bulges on domestic armed conflict, 1950-2000." Social Development Papers: Conflict and Reconstruction Paper 14.

Ware, H. 2004. "Pacific instability and youth bulges: the devil in the demography and the economy." Paper delivered at the 12th Biennial Conference of the Australian Population Association, 15-17.

Wagner, Adolph. 1892. *Grundlegung der Politischen Ökonomie*. Leipzig: C.F. Winter Publishing Firm.

World Bank. 2011. *World Development Indicators 2011.* Washington, DC: World Bank. Available at http://data.worldbank.org/data-catalog/world-development-indicators