

Civil War Prediction and Insurance against Political Violence
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Summary: Political risk insurers find one of the hardest risks to underwrite is political violence (“PV”). Compared to other insurance covers, claims for PV are infrequent and usually total (no recovery). While factors related to the specific location of the insured asset’s location are very important in evaluating a given proposal’s risks, PV underwriters also examine country risk when they offer protection to investors against political violence. Focusing on civil war is one way to gauge this aspect of country risk, as civil war can spread throughout a country and historically is more common than interstate war. Employing a new measure of ethnic polarization devised by Montalvo and Reynal-Querol, this paper uses logit analysis to produce likelihood estimates of civil war in five-year periods. The results indicate that ethnic polarization – along with oil dependency, size of population, level of per capita income, and time since the last civil war – helps predict the onset of civil war. To make the analysis forward-looking, I employ estimated logits to forecast civil war onset in the 2005-2010 period. Converted to country rankings, these forecasts correlate closely to ratings of political violence produced by: 1) a major consulting firm and 2) a political risk insurance company. Where the ratings diverge, the logit-based rankings suggest higher risk in more populous countries (China, India) and those with greater ethnic polarization (Malawi, Ethiopia, Sri Lanka).

1. Introduction to PV Insurance

Both equity investors and lenders frequently purchase political risk insurance when investing in countries where they have little prior experience and/or where they have reason to believe government actions or weakness could lead to asset or profit losses beyond normal commercial risks. Sometimes called “investment insurance”, political risk insurance usually protects assets rather than individuals. Other forms of insurance (e.g. life, health, directors and officers’ liability, kidnap and ransom) are available to protect the people who work in the recipient country. However, PV insurance may also include “forced abandonment”, which protects against events which force a project’s employees to abandon the project to save their lives.

Standard property covers such as fire insurance sometimes include PV as an add-on. For example, the policies that paid claims after the World Trade Center attack were standard property policies that included a PV rider. In many cases property insurance does not protect against PV, however, as the policy language frequently states that coverage ceases if normal law and order conditions do not prevail.

Given the difficulty in forecasting PV and the high cost of claims if PV occurs, most insurers do not write “stand-alone” PV. Instead, they offer PV cover only along with other covers such as confiscation or currency inconvertibility in order to earn more premium on a given project while splitting the risk across what they believe are only partially correlated risks. Alternatively, they refuse to issue PV cover in many of the countries deemed to offer most risk.

PV underwriters commonly insure loss of assets due to strikes, riots, civil commotion, guerrilla attacks, civil war, and international wars. Usually PV policies exclude damages caused by conflicts that involve one of the five “Great Powers” (the US, UK, France, Russia and China) as well conflicts that involve the use of nuclear bombs. Frequently there are questions as to whether the forces involved in any given conflict sought political, ideological, or religious ends, or were merely attempting to loot or extort funds from a given investment project. In such cases, the insured and the insurance company may seek the advice of diplomats or arbiters.

Usually the insured assets enjoy protection commensurate with their value. Insureds safeguard their projects by paying for guards, fences, alarms and excellent communications with local military and police forces. Moreover, insureds may be developing natural resources in isolated areas that are much safer than major population centers, about which news media provide ample information. Additionally, they may be able to show that in the immediate neighborhood of their project there is no history of PV. Consequently, the PV underwriter may feel comfortable issuing policies in countries in which armed conflicts are ongoing, such as Colombia, or Iraq.

2. War and PV Insurance

While armed conflict on any scale can result in PV claims, both international and civil wars are especially threatening even for projects that are well protected, isolated, and/or historically safe. When nations employ force, they frequently utilize airplanes and long-range artillery or rockets that can reach assets in isolated areas. The same is true in the case of civil wars, especially those that spread throughout the territory of a country. One side may feel it can weaken an opponent's political support or ability to fight by destroying power plants, gold mines or cell phone networks. Moreover, in either international or civil wars, the scale of the conflict is more likely to lead to unintended consequences than when small armed bands with limited resources and better local knowledge resort to violence.

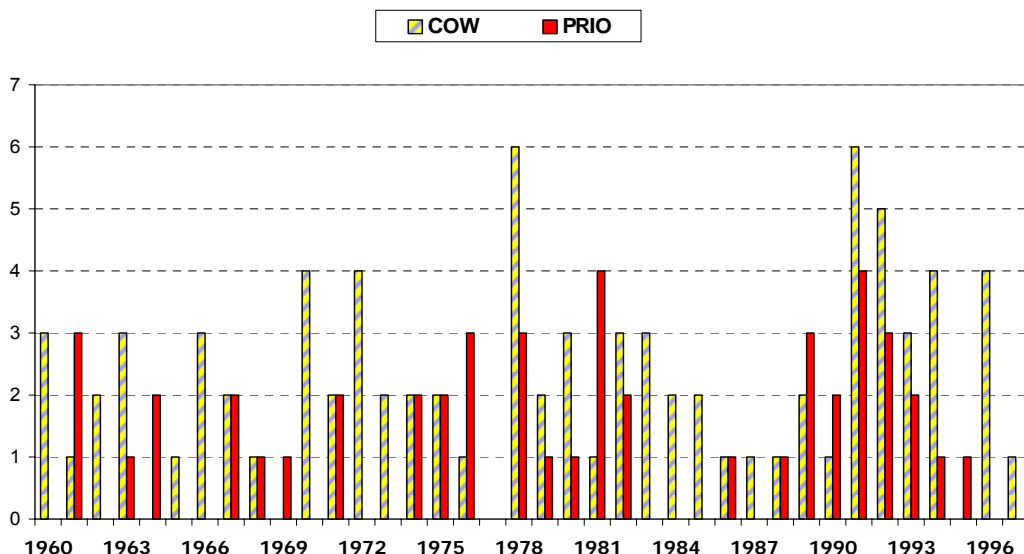
Social scientists have been keeping detailed records on wars and civil wars for decades. Two major compilations – that known as the Correlates of War (“COW”) and that collected by the Peace Research Institute Oslo (PRIO) and the Department of Peace and Conflict Studies of Uppsala University¹ – are among the best known. The COW data begin in 1815 and currently end in 1997. The PRIO data begin in 1946 and currently end in 2004. Both data collection projects use number of battle-related fatalities to decide when an armed conflict should be considered a war. COW requires an interstate war to result in at least 1,000 deaths over the course of the conflict and a civil war to lead to at least 1,000 casualties within a single year. The PRIO Conflict Data Project considers that any war must cause at least 1,000 deaths within a single year. Moreover, the COW project looks at more countries than did PRIO. As a result, the number and dating of wars and civil wars by the two projects do not always match. The graphs below compare COW and PRIO in terms of the number of war starts or “onsets” from 1960 through 1997. For the period as a whole, COW counted 84 civil war onsets and 18 international wars, while PRIO counted only 48 civil wars and 13 international wars.²

¹ Here I use version 3 of COW, per Sarkees, Meredith Reid, “The Correlates of War Data on War: An Update to 1997”, *Conflict Management and Peace Science*, 18/1(2000), pp. 123-144, available at <http://cow2.la.psu.edu>. The PRIO data originated from Gleditsch, Nils Petter, Peter Wallensteen, Mikael Eriksson, Margareta Sollenberg and Håvard Strand, “Armed Conflict 1946-2001: A New Dataset”, *Journal of Peace Research*, 39/5 (2002), pp. 615-637, available at <http://www.prio.no>. The PRIO data are updated annually; the most recent year available is 2004.

² Seybolt examines 16 differing data sets, including COW and PRIO and concludes that the criteria used in defining the data may determine the conclusions reached. Seybolt, Taylor B., “Measuring Violence: An Introduction to Conflict Data Sets”, Appendix 1C, *SIPRI Yearbook 2002*. One especially interesting point is that using an absolute number of fatalities to separate wars from minor conflicts may be inappropriate in smaller nations, where a conflict that causes 200 or 500 deaths may well cause as much social havoc as a war with thousands of fatalities in a more populous nation. See also Eck, Kristine, “A Beginner’s Guide to Conflict Data”, UC DP Paper Number 1, December 2005, 81 pp., Uppsala, Sweden, available at <http://www.pcr.uu.se>. Ms. Eck identifies 53 armed conflict datasets.

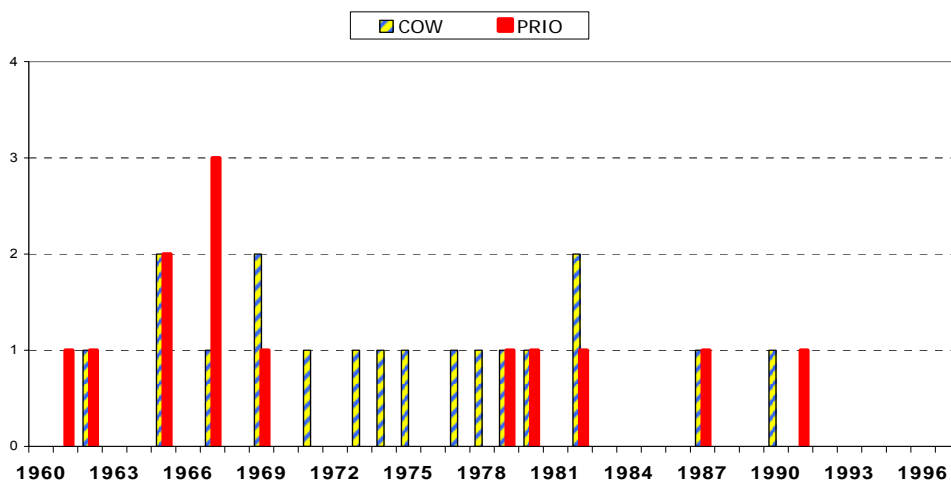
Number of Civil Wars That Began in Each Year

Comparison of COW and PRIO Sources



Number of International Wars That Began in Each Year

Comparison of COW and PRIO Sources



As seen, COW includes a higher number of wars than does PRIO. Thus choice of the COW dataset may, if anything, tend to give higher estimates of the likelihood of loss due to PV.

Using either dataset, one perceives the beginning of a waning of international or interstate wars over time. As Table 1 below shows, COW counted 13 interstate wars in the 1960s and 1970s and then only 5 in the 1980s and the 1990s up to 1997. The PRIO source goes from 9 in the 1960s and 1970s to 5 in the 1980s and 1990s. In contrast, both sources show a higher number of civil wars in the 1980s and 1990s than in the 20 preceding years.

Table 1
Number of Wars per Decade, by Source

	Interstate Wars		Civil Wars	
	COW*	PRIO**	COW*	PRIO**
1960s	6	8	16	10
1970s	7	1	25	13
1980s	4	3	19	12
1990s	1***	2	24***	16

* COW = "Correlates of War" project
 ** PRIO = Peace Research Institute Oslo
 *** Only to 1997

Martin van Creveld suggests that major wars have been on the decline since at least 1980 and most likely 1945. He attributes this to the introduction of nuclear weapons, the reduction of the size of military forces all around in response to the rising price of military hardware, and a basic change in international mores that characterized territorial annexation as illegitimate. As a consequence, he suggests recent and future wars likely will involve third- and fourth-rate states.³

Given the history of many more civil wars than interstate wars and indeed a waning of major wars, the analysis that follows deals exclusively with civil wars. As of this date, COW data stop in 1997. To update the analysis, I added to the COW data from 1998 through 2004 using PRIO data. Since both teams of researchers use a mortality floor of 1,000 deaths to define a civil war, the series are roughly similar. Mixing the two series – COW at the beginning, PRIO at the end – could produce parameters that over-forecast the onset of civil war in the 2000-2004 period, especially if estimation stops at 1999.

The data refer exclusively to the onset or start of civil wars. If a civil war is ongoing in year “x” but had already reached the threshold to be considered a civil war before year “x”, then year “x” does not count as a civil war onset. However, if one or more new civil wars break out in this year, then each of them will count. The analysis that follows focuses only on civil war onset, not duration or the severity of civil war.

3. Correlates or “Causes” of Civil War

Over the past three decades researchers have tested a series of relationships in an effort to better onset what leads to civil war onset, severity, and duration. Melvin Small and J. David Singer put together one of the first datasets with extensive chronology and measurements related to war.⁴ Their careful data collection started what

³ Creveld, Martin van, “The Waning of Major War”, pp 97-112, in Väyrynen, Raimo (ed.), *The Waning of Major War* (Routledge, New York, 2006).

⁴ Small, Melvin and J. David Singer, *Resort to Arms: International and Civil Wars, 1816-1980* (Sage, Beverly Hills, California, 1982).

is commonly referred to today as the COW (“Correlates of War”) project. Important points included a listing of sovereign states as well as careful dating of the beginning and ending of each conflict. Singer and Small divided international wars into two categories: intra-systemic or inter-state wars, and extra-systemic wars. By extra-systemic wars they meant wars in which a sovereign state engaged in war with part of its empire or opponents in its colonies (e.g. the second Kashmir war of 1965). Just two years later they defined and included civil wars in their dataset. For many years political scientists were the major beneficiaries of this work.

Economic historians and development economists also touched the subject from time to time.⁵ And in the early 1990s, provocative work by Huntington and Fukuyama led to new work on war, as the two authors came to quite different conclusions – Huntington that wars would multiply, Fukuyama that they would become more infrequent.⁶

More recently Collier and Hoeffler have produced a wealth of studies that extend previous work by testing measures of economic and geographic factors as well as the more traditional factors of inequality, repression, and religious and ethnic differences.⁷ Experts on Africa, they sought explanations for the series of armed conflicts tearing the continent apart. Their work highlighted the way in which the existence of primary commodities as well as diasporas facilitated rebellions by serving as a source of finance. They also introduced a measure of how mountainous countries are; this variable represented the physical difficulty that governments would face in suppressing armed rebellions. In contrast with some preceding work, they argued that countries with multiple ethnic groupings would be less prone to civil war.

Political scientists James Fearon worked over these results and concluded that they suffered from a series of methodological and data problems. He particularly disliked the use of “primary commodities” per se and focused on the existence of oil as the relevant variable. However, he interpreted the statistical association between oil wealth and frequency of civil war onset to the poor governance that characterized oil-rich regimes; however, he did not reject out of hand the idea that the funds generated by oil could fuel civil wars.⁸

Attracted by the debate, Håvard Hegre and Nicholas Sambanis put together a statistical tour d’horizonte, in which they look at the frequency with which a given variable or set of variables is strongly related to civil war onset under different specifications. The idea is that variables that are robustly related to the outbreak of hostilities should enjoy a senior status in future analyses, compared to other variables that sometimes work and sometimes do not. Per capita income, size of population and time at peace all make the cut, as robustly related to civil war onset. Neighborhood effects -- that is, the tendency for civil war in the vicinity to spread—as well as low rates of GDP growth, the prevalence of rough terrain, institutional instability and incomplete democracy also merit mention. However, Hegre and Sambanis find that measures of oil and primary commodity dependence only show a reliable relationship to outbreaks of armed conflict that do not reach the level of civil

⁵ Olsen, Mancur, The Rise and Decline of Nations (Yale University, New Haven, CT, 1982); Lucas, Robert Jr., “On the Mechanics of Economic Development”, Journal of Monetary Economics, 22(1), pp. 3-42 (1988).

⁶ Huntington, Samuel P., The Clash of Civilizations and the Remaking of the World Order (Simon and Schuster, New York, 1996); Fukuyama, Francis, The End of History and the Last Man (Free Press, New York, 1992).

⁷ Collier, P. and A. Hoeffler, “On the Economic Causes of Civil War”, Oxford Economic Papers, 50, pp. 563-573 (1998). See also by the same authors “Greed and Grievance in Civil War”, Oxford Economic Papers, 56, pp. 563-595 (2004).

⁸ Fearon, James D., “Primary Commodity Exports and Civil War”, Journal of Conflict Resolution, 49(4), pp. 483-507 (August 2005). See also Fearon, James D. and David D. Laitin, “Ethnicity, Insurgency and Civil War”, American Political Science Review, 97(1), pp. 75-90 (2003). Fearon and Laitin devise a slightly different definition of civil wars from COW and PRIO; it includes the requirement that both sides to the conflict suffer meaningful casualties.

war. Moreover, most of their ethnic variables show a fragile relationship with civil war onset, although a measure of ethnic dominance proves more robust.⁹

4. Description of Variables

a. Civil War Onset (CW)

The dependent variable in this study is the onset of civil war rather than simply “armed conflict”, as one of the target audiences – political risk underwriters and insureds – should be interested in widespread conflict rather than minor conflagrations, for reasons described above. The dataset I used is the Correlates of War (“COW”), which appears to be more comprehensive than the PRIO dataset. Defined initially by Singer and Small as “intrastate conflict”, a civil war onset (CW) occurs in the COW dataset when there is sustained conflict between the armed forces of the government and forces of another entity either for control of the country or over local issues. To count as a civil war the event must lead to 1,000 battle-related fatalities per year. Both military and civilian deaths are included in this total, although massacres are excluded. Available at <http://cow2.la.psu.edu>, the dataset currently runs from 1816 through 1997.

I use five-year aggregates of the COW data, taking the 1960 through 1994 data from Collier and Hoeffler’s 2002 study. The definition of the CW variable is start or beginning of a civil war, so if no civil war was active in the years 1960 through 1964 in country “x”, for example, and a civil war began in 1965, CW for this country is set equal to 1 in the 1965-1969 period. If no civil war breaks out between 1965 and 1969, CW is set equal to 0. If a civil war is ongoing in 1964, however, and continues to 1995, CW for country “X” is considered to be missing. The exception to this rule is that if a new civil war begins in 1965 in country “X” while the old civil war continues, then CW is set equal to 1 in the period 1965-69.¹⁰

Considering CW to be missing when an ongoing civil war continues from one five-year period to another follows other studies in the literature but is a priori slightly unsettling. Since violence continues, why not set CW equal to 1 instead? The answer obviously is that it is the beginning or onset of the war that one is examining here, not its duration. In any event, Hegre and Sambanis tried coding periods of ongoing war as 0 and found that it made “no significant difference” to their results.¹¹

To expand the dataset to the present, I build a 1995-1999 variable by using the COW dataset for 1995, 1996 and 1997, and then the PRIO dataset for 1998 and 1999; for 2000 through 2004 I use just the PRIO dataset. Whenever I use the PRIO dataset, I count only the “major” armed conflicts, that is, those with 1,000 or more fatalities. As seen above, PRIO records fewer civil wars than COW. Accordingly, my methodology – necessary in the absence of an update of COW – tends to bias the dependent variable downward in the most recent years, with the bias most pronounced in the 2000-2004 period. It follows that extrapolations from the entire 1960-2004 period should predict more civil wars onsets in 1995-1999 and 2000-2004 than my bootstrapped series.

b. Population

⁹ Hegre, Håvard and Nicholas Sambanis, “Sensitivity Analysis of Empirical Results on Civil War Onset”, *Journal of Conflict Resolution*, 50(4), pp. 508-535 (August 2006).

¹⁰ No cases of two or more simultaneous civil wars in the same country occur in my dataset for the 1960-2004 period.

¹¹ Hegre and Sambanis, *op. cit.*, p. 523.

Population size should be positively related to CW for two reasons. First, if the per capita tendency to civil war is constant across nations, then the larger the population, the higher the tendency to start a civil war. Second, since the threshold for an armed conflict to reach civil war magnitude is the arbitrary 1,000 deaths, it is likely that some “true” civil wars will not reach this level and therefore will not be counted in countries with smaller populations¹². I follow the common practice in the literature of using the natural logarithm of population (in millions) to allow for non-linear relationships. We take population in the beginning year of each period (e.g. 1990 for the 1990-94 period).¹³

c. Per Capita Income

One of the common findings in the literature is that nations in which average per capita income is high experience few or no civil wars. There are at least two interpretations of this relationship. One is that high per capita income is a proxy for stronger government organization, which is better able to respond to grievances and suppress rebel forces. A second possible explanation is that income represents the opportunity cost of going to war. Countries with higher per capita incomes usually provide more years of schooling and tend to have lower unemployment rates than poorer countries. In such countries it is more difficult to convince individuals to abandon their livelihoods and adhere to a risky rebellion that may lead nowhere. To measure this variable, I follow the common practice and use the natural logarithm of real per capita income. The underlying measure is real GDP per capita at the beginning of each five-year period.¹⁴

d. Time at Peace

Another common finding in the literature is that the longer peace has prevailed, the less likely it is that civil war will occur. One explanation offered by Collier and Hoeffler is that this may reflect the opportunity cost of rebellion. A country that recently experienced civil war is more likely to have a stock of weapons, a number of individuals who know how to use them, and the remnants of a rebel organization.¹⁵ Consequently, the cost of renewed rebellion is lower. An alternate explanation would be that as the survivors of past civil wars die, the less important old grievances seem to younger generations.

Both COW and PRIO datasets help to measure this variable, as each defines the month and year in which every civil war begins and ends. Accordingly, time at peace can be measured as the number of months from the end of a previous civil war to the beginning of each five-year period. For those countries which have never experienced a civil war, the end of World War II (September 1945) is taken as the start date, and the number of months at peace in the 1960-64 period is set equal to 172. Inasmuch as it is likely that the effect of time at

¹² Clearly this is a defect in the definition and could be the subject of future investigations.

¹³ This requires a population forecast in order to predict civil war onset in future years. However, for most countries population changes little from one year to the next and so simple extrapolation introduces little error. This would not be true if a natural disaster or major conflict dramatically reduces population from one year to the next. Population data for 1960 through 1995 are taken from Collier and Hoeffler (2002). Data for 1995 through 2005 come from IMF, World Economic Outlook, September 2006.

¹⁴ This also requires a forecast, and real per capita income exhibits much larger percent variables from one year to another than does population. Moreover, if income suddenly dropped at the end of a five-year period and then rebounded to “normal” levels in the following years, the use of a one-year measure introduces error into the dataset. Future researchers may wish to experiment with average income measures. Real per capita income for 1960 through 1990 is taken from Collier and Hoeffler (2002), who used the Penn world tables and created figures for later years by applying annual percent increases in real per income to their historic figures. I built figures for the 1995-99, 2000-2004, and 2005-2009 periods by applying annual percent increases in real per capita income to Collier and Hoeffler’s numbers, again using data from the IMF’s September 2006 World Economic Outlook.

¹⁵ Collier and Hoeffler, op. cit., p.569.

peace is greater in the early years and less as time progresses, I follow Hegre and Sambanis and utilize a “peacetime” variable calculated as $2^{-(\text{months at peace}/12)/8}$.¹⁶ Note that this specification produces smaller, not larger numbers as more years pass without war.

e. Dependence on oil

While political scientists and others have discussed the “curse of oil” for some time, a series of conflicts over the last 30 years in Angola, Colombia, the Democratic Republic of the Congo, and Sudan renewed interest in the connection between war and natural resource endowment. Collier and Hoeffler were pioneers in emphasizing the correlation between the existence of natural resource wealth and the onset of civil war.¹⁷ They and others argued that one of the incentives to rebellion is the availability of loot to reward supporters. Cash from resources is the motivation for their use of the term “greed” to describe their original model of civil war onset. Another explanation offered is that oil-rich governments do not depend on the consent of the governed for revenue and consequently may be poor providers of public services, tolerate corruption or pay little attention to politically important variables such as employment generation. Fearon subsequently argued that crude oil rather than generalized natural resource endowment is much more closely related to civil war onset. Collier and Hoeffler continue to refine their analysis, however, and are now utilizing a measure of rents derived from natural resource endowments to represent the temptation to rebellion.¹⁸

As a first approximation, I prefer to utilize the measure that Collier and Hoeffler originally used and which Fearon also found to be well correlated, which is the ratio of crude oil exports to GDP. Crude oil prices vary widely, so to smooth the data I take the average ratio of crude oil exports to GDP in the preceding five-year period. As an example, the average ratio of crude oil exports in Angola to GDP over the 1980-84 period would help explain civil war onset in the 1985-89 period.

f. Ethnic Polarization

One of most hotly debated causes of civil war onset has been the degree of ethnic friction. The presence of ethnic differences could lead to civil war through many conduits. Ethnic groups could be more cohesive and therefore favor the recruitment of soldiers, discrimination against certain groups could increase resentment, and different ethnicities might concentrate in different areas of the country leading to a de facto division. Many of the major articles from the 1990s on have examined the impact of ethnic differences, with varying results. Collier and Hoeffler found that ethnic fractionalization (a measure of the division of a given country into different ethnic groups) and ethnic dominance (set equal to 1 if one group represents 45% to 90% of the population, 0 otherwise) were only weakly related to civil war onset. Fear and Laitin agreed and found that a greater degree of ethnic diversity – what Collier and Hoeffler labeled “fractionalization” – does not make a country more prone to civil war. Their logit results show neither ethnic nor religious fractionalization to be strongly related to the outbreak of civil war.

Blimes countered that researchers should be looking at indirect correlations of ethnic differences with civil war. His idea is that ethnic conflicts weaken a society and leave it vulnerable to civil wars when other stresses

¹⁶ Hegre and Sambanis, *op. cit.*, p. 512.

¹⁷ Collier and Hoeffler, “Economic Causes of Civil War”.

¹⁸ Collier and Hoeffler, “Resource Rents, Governance and Conflict”, *Journal of Conflict Resolution*, 4(4), pp. 625-633 (August 2005).

appear.¹⁹ More directly, Montalvo and Reynal-Querol suggest it is ethnic polarization rather than fractionalization that leads to civil war.²⁰ They construct a measure of polarization by measuring how far the distribution of ethnic groups in a country deviates from a bipolar distribution (50% ethnicity “A”, 50% ethnicity “B”). Their formula is:

$$\text{ETHPOL} = 1 - \sum \pi_i((1/2 - \pi_i)/(1/2))^2$$

Here π_i is the proportion of the population that belongs to ethnic group i , and summation occurs over all groups. They then test this measure of ethnic differences by estimating a series of logit regressions on the incidence of civil wars from 1960 through 1999, using different datasets. They find ETHPOL is be strongly and positively related to onset over a variety of specifications.²¹

Given the generally poor results with ethnic fractionalization and Montalvo and Reynal-Querol’s good results with polarization, I use their measure of polarization throughout. This clearly is a relatively crude measure, as they provide only one table of polarization coefficients estimated with data from the 1982 World Christian Encyclopedia. Logically the degree of polarization in any country will change over three decades as a result of inter-ethnic differences in migration, fertility and longevity. If conflicts characterized by “ethnic cleansing” occur, even more dramatic changes will occur. This is clearly an area for further research.

g. Mountainous Terrain

In a 1999 study Fearon and Laitin found that what they labeled “geographic fractionalization” favored civil war onset.²² Subsequently Collier and Hoeffler (2004) reported that a variable that represents the percent of a country’s land area that is mountainous was robustly and positively related to the start of civil wars. Hegre and Sambanis also list this variable as one of the better explanations of civil war onset. The idea is that the cost of rebellion will be lower if it is easier for insurgents to hide and therefore civil war will be more likely in countries with rugged terrain.

Fearon and Laitin (2003) note that this concept would be better specified if the existence of jungles and swamps were also included. However, given the good results of prior studies, I use the mountainous terrain variable as given in Collier and Hoeffler’s 2004 study.

h. Anocracy

Fearon and Laitin (2003) point to some studies that suggest there is an “inverted-U” relationship between democracy and civil wars. The idea is that social tensions are released in democracies and suppressed in autocracies, but in the in-between state of anocracy (not fully democratic, not completely dictatorial) tendencies to rebellion are freer to proliferate. Both Fearon and Laitin and Hegre and Sambanis find that the dichotomous

¹⁹ Randall Blimes, “The Indirect Effect of Ethnic Heterogeneity on the Likelihood of Civil War Onset”, Journal of Conflict Resolution, 50(4), pp. 536-547 (August 2006).

²⁰ Jose G. Montalvo and Marta Reynal-Querol, “Ethnic Polarization, Potential Conflict and Civil Wars”, American Economic Review, 95(3), pp. 796-816 (June 2005)

²¹ Hegre and Sambanis did not find ethnic dominance to be robustly related to civil war onset but only utilized Collier and Hoeffler’s dichotomous measure of polarization and an alternative measure from Fearon and Laitin that gives the share of population in the second largest group. See Hegre and Sambanis, op. cit. p. 521.

²² J. D. Fearon and Laitin, D.D., Weak States, Rough Terrain and Large-scale Ethnic Violence since 1945, unpublished manuscript, 1999, Stanford University, cited in Nicholas Sambanis, “A Review of Recent Advances and Future Directions in the Quantitative Literature on Civil War”, Defence and Peace Economics, 13(3), pp. 215-243 (2002).

variable anocracy is robustly and positively related to civil war onset. Humphreys finds that a measure of regime “strength” (which he calculates as equal to (1-a measure of political instability) X (1-anocracy) is negatively and strongly related to civil war onset.²³ Given the relatively consistent support for this variable in the literature, I introduce it, taking data from Hegre and Sambanis. Inasmuch as they provide annual data, I produce an anocracy variable using their measure in the last year preceding each of my five-year periods. For example, Hegre and Sambanis’s anocracy in year 1964 for Afghanistan becomes my measure of anocracy for Afghanistan in the 1965-69 period.

i. Growth

Some studies find that growth rates are negatively related to civil war onset.²⁴ The logic is that if the society in general appears to be making material progress, it is more difficult to attract fighters to a rebel force. While Fearon finds a strong and negative relationship between lagged economic growth rates and civil war onset in his 2005 article on primary commodity exports and war, in his 2003 piece with Laitin they argued that this relationship probably resulted from a well financed and administratively competent government rather than the growth variable. They also suggested that the lag using five-year periods might be so long as to be meaningless, that is, growth in the 1985-89 period might not be truly related to civil war onset in 1994.

Taking into account the number of studies that indicate the usefulness of this variable, I include it, using average annualized growth in real per capita income in the four years preceding each five-year civil war onset period. For example, I relate income growth for the 1986-89 period to civil war onset occurring in the 1990-94 interval. I calculated growth rates from the Penn tables in the main; for some 80 countries for which 2000 to 2004 growth rates were not available, I used data from the IMF’s September 2006 World Economic Outlook tables.

5. Empirical Results

Table 2 relates the means and standard deviations of the variables in my dataset over the period 1960-2000.

Table 2 - Descriptive Statistics

Variable	Mnemonic	N	Mean	Std. Dev.	Minimum	Maximum
Civil War Onset	warsa	1,263	0.063	0.244	0	1
Population	lnpop	1,367	15.532	1.830	10.638	20.960
Per Capita Income	lngdp_	1,179	7.778	1.079	2.603	10.433
Time at Peace	pt8	1,260	0.176	0.221	0.009	0.993
Oil Dependence	oilexp	1,156	0.058	0.179	0	2.139
Ethnic Polarization	polar	1,187	0.518	0.242	0.017	0.982
Mountainous Terrain	mount	1,390	17.281	21.755	0	94.300
Anocracy	anocracy	1,381	0.178	0.383	0	1
Real GDP Per Capita Growth	gy1	1,109	1.877	4.206	-25.340	40.880

²³ Macartan Humphreys, “Natural Resources, Conflict and Conflict Resolution”, *Journal of Conflict Resolution*, 49(4), pp. 508-537 (August 2005).

²⁴ Collier and Hoeffler (2004); Collier and Hoeffler (2005); Fearon (2005); Hegre and Sambanis (2006).

Anocracy and mountainous terrain are constants over the 1960-2000 time period.

The relationship between civil war onset and these explanatory variables is explored via logit analysis, with the results shown in Table 3.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Constant	-1.962	-1.352	-2.666	-2.783	-2.404	-3.733	-3.420
	1.588	1.892	1.716	1.862	2.000	1.985	2.273
pt8	2.180***	2.369***	2.290***	1.808***	2.207***	1.718***	1.707**
	.442	.474	0.461	.508	0.475	0.517	0.532
lnpop	.187**	.248***	0.190**	.256***	.276***	0.265***	.312***
	0.080	.094	0.083	.095	0.098	0.098	.113
lngdp_	-.584***	-.831***	-0.612***	-.611***	-.865***	-.622***	-.811***
	0.147	.183	0.154	.164	.188	0.167	0.202
polar			1.502**		1.657*	1.666**	1.681*
			0.710		0.770	0.797	0.845
oilsexp		2.387***			2.402***		2.129*
		.812			0.814		1.055
gy1				-0.078*		-0.084*	-.063
				0.042		0.044	0.044
anocracy							0.197
							0.360
mount							0.007
							.007
Pseudo R ²	0.1376	0.1904	0.1567	0.1553	0.1993	0.1726	0.1908
N	1108	1007	1023	974	962	920	871

Notes: Standard errors in parentheses. ***, **, * indicate significance at 1, 5 and 10 percent level, respectively

Clearly time at peace, per capita income and size of population – Hegre and Sambanis’s core variables – are strongly related to civil war onset. The longer the time at peace, the higher the per capita income, and the smaller the population, the less likely a civil war will take place. The positive sign on pt8 – the decay function for time at peace – results from the way the variable has been constructed, with pt8 negatively and non-linearly related to time at peace.

Dependence on oil, ethnic polarization, and per capita income growth also exhibit strong and positive ties to civil war onset, per columns 2, 3, and 4 in Table 3. However, per capita income growth drops out when included with the core variables and polarization. Oil dependence remains significant, and the regression of column 5 above also produces the largest pseudo R². If measures of ethnic polarization for five-year periods were available, perhaps its relationship would have been more significant.

Neither mountainous terrain nor anocracy is strongly related to the outbreak of civil war in this dataset of forty years, although the sign of the coefficient for both is as expected. Introduction of time at peace and per capita income reduces the strength of the tie between mountainous terrain and civil war onset to insignificance as does introduction of size of population and per capita income. However, when time at peace, size of population and terrain are the only explanatory variables, terrain still manages to reach the 5% level of significance, with the expected positive sign.

The relationship of anocracy to civil war is even weaker. Introduction of any of the core variables of time at peace, per capita income or size population reduces its significance below the 10% level. Perhaps this reflects the relative crudeness of this dichotomous measure.

Taking model (5) from Table 3 as the best approximation of the empirical relationship -- that is excluding anocracy, mountainous terrain, and per capita income growth -- provides good coefficients on the variables but relatively low predictive power, as indicated by the pseudo R². The classification table for the 2000-2004 period also is disappointing. In the PRIO dataset only two civil war onsets occurred in this period -- Liberia and Sudan. The estimated logit model produces probability estimates of civil war onset for both countries in this period that fall short of 50%. In fact, the model predicted no civil wars in the period which -- given the low number of civil war onsets -- was accurate but not helpful to the political risk underwriter who had the misfortune to issue PV policies in either of these two countries. It is perhaps comforting that the model generated a probability 38% for civil war in the Sudan in 2000 -- second only to Ethiopia.

6. Comparison to Country Risk Ratings

Consultants, academic institutes, government departments and insurance companies provide country ratings of the likelihood that political violence will occur.²⁵ By plugging in values of the right-hand variables to model (5) above, one can generate a country ranking that can be compared to these other sources. Appendix A provides the probabilities of civil war onset generated by the logit model for the 2005-09 period.

I compare two sources of country risk ratings to these model-generated probabilities in Table 4 below. Spearman and Kendall correlation coefficients are the appropriate statistic for this purpose, since the two sources of comparison represent ordinal rankings with frequent ties between countries. One source is the end-of-year forward-looking security ratings from Control Risks, a consulting firm headquartered in London. While Control Risks constantly updates its ratings, these ratings -- for terrorism, security, politics and travel -- relate to the current state of each country rather than a forecast. Once a year in November Control Risks produces a risk map, and the ratings for this map represent a one-year forecast.

²⁵ For example, the Center of International Development and Conflict Management (CIDCM), the Fund for Peace, the Political Risk Service, Global Insight, Control Risks and Belgium's ONDD all produce country ratings of political violence. Global Insight, in particular, produces a forecast of the risk of civil war that became available too late for inclusion in this paper.

The second source is the political violence rating my firm AIG Global Trade & Political Risk Insurance uses as it underwrites investments and loans around the world. Since updates to these ratings occur at irregular intervals, I use the January 2005 and the December 2005 ratings.

Table 4 - Nonparametric Correlations between Model-Generated Probability of Civil War Onset and Alternate Ratings of Risk of Political Violence, 2005 and Future (Number observations = 105)				
Spearman Correlation Coefficients				
	Model Probability	Control Risks	AIG January 2005	AIG December 2005
Model Probability	1.000			
Control Risks	0.542	1.000		
AIG January 2005	0.681	0.553	1.000	
AIG December 2005	0.654	0.556	0.920	1.000
Kendall Correlation Coefficients				
	Model Probability	Control Risks	AIG January 2005	AIG December 2005
Model Probability	1.000			
Control Risks	0.323	0.537		
AIG January 2005	0.458	0.320	0.820	
AIG December 2005	0.435	0.323	0.735	1.000
Note: All correlations significant at 1%				

While the relationship is tight and all the rankings basically put countries in the same order, there are interesting differences. The model is more optimistic (that is, it forecasts a lower probability of violence) in Saudi Arabia and Bangladesh than is Control Risks. The model is more pessimistic for China, Peru, Sri Lanka, India, Ethiopia and Angola. While Saudi Arabia is the quintessential oil dependent economy, its per capita income is high and population size low. Ethnic polarization is low in Bangladesh, and it is not an oil exporter. For China and India, large population size is boosting the forecast probability. In Ethiopia and Sri Lanka, ethnic polarization is high. Angola has relatively high polarization and is oil dependent.

For the AIG ratings, the model suggests more optimistic ratings are appropriate for the risk of violence in Argentina, Paraguay, Fiji, Papua New Guinea, and Venezuela. Ethnic polarization is relatively high in all these

countries (0.93 in Fiji!), but they have relatively small populations. In the case of Fiji the historical record shows no previous onsets of civil war, perhaps reflecting the artificial criterion of one thousand deaths imposed by the datasets. Given the very high risk ratings AIG assigned these countries (“E” for Argentina and Paraguay”, “off cover” for the others, perhaps for reasons in addition to perceived violence risk), the model’s lower rating appears to be reasonable.

Conclusions

Logit analysis using a large dataset and a measure of ethnic polarization produced estimates of the probability of civil war onset that have weak predictive power when tested against actual onset during the 2000-2004 period. However, the signs of the coefficients on explanatory variables accord with results in other studies. Many of the variables utilized in the literature – time at peace, per capita income, size of population, growth rates, and oil dependency – showed a relatively high statistical relationship to civil war onset. However, two measures previously found to be useful in other studies – mountainous terrain and anocracy – did not enter the most useful model. When the logit model is used to order a rather bewildering history of political violence around the world, its forecasts rank risk across countries in much the same way as two available sources of political violence ratings.

Analysis of civil war onset might be more useful in this regard by adapting the definition of civil war to fit the reality of many of the small developing countries around the world. These countries may have civil wars that do not generate one thousand or more deaths in a given year; the datasets used in this study therefore underestimate the likelihood of conflict in these countries. Additionally, as even the single-year measure of ethnic polarization helps explain civil war onset, research that produces data on changes in the ethnic make-up of countries over time should lead to improved understanding of the likelihood of such conflict. To the extent that low per capita income is one of the major correlates of civil war, efforts to eliminate poverty and raise living standards around the world hold the promise of lowering the risk of such disasters over time.

Appendix A: Model-Based Probability of Civil War Onset, 2005-09

Country	Prob.	Country	Prob.
Angola	12.9%	Grenada	1.3%
Argentina	2.5%	Guatemala	8.7%
Australia	0.8%	Guinea	6.7%
Austria	0.5%	Guinea Bissau	8.4%
Bahamas	0.6%	Guyana	3.0%
Bahrain	0.5%	Honduras	3.0%
Bangladesh	2.0%	Hungary	0.6%
Barbados	0.5%	Iceland	0.1%
Belgium	1.4%	India	10.8%
Benin	3.4%	Indonesia	6.1%
Bolivia	4.9%	Iran	3.2%
Botswana	1.1%	Ireland	0.3%
Brazil	5.6%	Israel	1.4%
Cameroon	6.4%	Italy	0.9%
Canada	1.1%	Jamaica	2.3%
Cape Verde	2.1%	Japan	0.8%
Central African Republic	10.1%	Jordan	3.2%
Chad	4.4%	Kenya	5.3%
Chile	2.0%	Korea	0.5%
China	5.5%	Kuwait	1.6%
Comoros	2.3%	Lesotho	2.2%
Congo (Braz)	2.2%	Luxembourg	0.3%
Costa Rica	1.2%	Madagascar	4.5%
Denmark	0.4%	Malawi	11.6%
Dominican Republic	3.0%	Malaysia	2.1%
Ecuador	4.0%	Mali	3.6%
Egypt	3.5%	Malta	0.3%
Ethiopia	28.4%	Mauritania	3.9%
Fiji	1.7%	Mauritius	0.9%
Finland	0.5%	Mexico	3.5%
France	0.9%	Morocco	6.4%
Gabon	2.2%	Mozambique	4.7%
Gambia	3.9%	Netherlands	0.5%
Germany	1.0%	New Zealand	0.5%
Ghana	3.2%	Nicaragua	6.9%
Greece	0.5%	Niger	12.2%

Country	Prob.	Country	Prob.
Norway	0.3%	Swaziland	0.9%
Oman	0.6%	Sweden	0.6%
Pakistan	8.9%	Switzerland	1.1%
Panama	1.6%	Syria	1.6%
Papua NG	5.4%	Togo	10.0%
Paraguay	1.9%	Trinidad	0.5%
Peru	13.5%	Tunisia	0.8%
Poland	0.8%	U.S.A.	1.7%
Portugal	0.5%	Uganda	6.3%
Rwanda	9.4%	United Arab Emirates	1.1%
Saudi Arabia	0.9%	United Kingdom	1.3%
Senegal	4.3%	Uruguay	1.5%
Sierra Leone	4.9%	Vanuatu	1.3%
Singapore	0.8%	Venezuela	3.4%
South Africa	3.8%	Zambia	7.3%
Spain	1.9%	Zimbabwe	13.3%
Sri Lanka	15.5%		