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MACROECONOMIC ASPECTS OF CONFLICT

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A Dissertation
Submitted in Partial Fulfillment of the Requirements for the
Doctor of Philosophy Degree

Department of Economics
in the Graduate School
Southern Illinois University Carbondale
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DISSERTATION APPROVAL

MACROECONOMIC ASPECTS OF CONFLICT

By

Eric Daniel Lenz

A Dissertation Submitted in Partial

Fulfillment of the Requirements

for the Degree of

Doctor of Philosophy

in the field of Economics

Approved by:

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August 7, 2015

AN ABSTRACT OF THE DISSERTATION OF

ERIC DANIEL LENZ, for the Doctor of Philosophy degree in ECONOMICS, presented on August 7, 2015, at Southern Illinois University Carbondale.

TITLE: MACROECONOMIC ASPECTS OF CONFLICT

MAJOR PROFESSOR: Dr. Zsolt Becsi

In the following papers I propose to construct economic models that incorporate the disastrous effect of conflict. I model conflict theoretically in a Solow growth model and empirically in a GDP per worker growth model, in a civil war onset model and a model for civil war's severity.

The first chapter theoretically and empirically analyzes economic growth with conflict in the context of the Mankiw et al. (1992) adaptation of the Solow growth model and the natural resource growth model by Sachs and Warner (1995). I incorporate a variable of capital destruction in the physical and human capital accumulation equations and derive coherent theoretical and empirical results.

The second chapter considers the onset of civil war across all countries and specific subsamples of countries from 1970 to 2007. The onset of war is modeled using economic and financial variables in addition to grievance variables from the political science literature to ascertain the extent to which financial crises and hyperinflation can bring about civil war. I estimate using panel time-series logistic regression techniques and discover the risk of conflict in Africa, Asia, highly-indebted poor countries, and low income countries. Some civil wars are fought for government control and others are fought over local issues - both types of war are controlled for with their own determinants.

The third chapter determines factors that significantly affect the severity of civil wars from year to year. I employ the same IV/GMM estimation techniques from Chapter 1 to discover the role of financial crises, hyperinflation, unemployment, and development assistance and aid in the severity of war.

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CHAPTER 1

CAN CONFLICT DIMINISH GROWTH?

1.1. Introduction

Does conflict diminish growth? Literature in growth and development is silent on the matter. However, it seems self-evident that conflict can lower GDP per capita by lowering capital and labor. Conflict's disastrous effects are highlighted by experiences in select countries:

For instance, in Figure 1 the Rwandan civil war began in 1990 and culminated in the genocide of as many as 800,000 people in 1994, but the economy did recover and GDP per worker rose to its antebellum level almost a decade later. In Figure 2, the ongoing Mexican drug war began in 2006 and resulted in at least 60,000 casualties, but the Mexican economy is still recovering. The recent conflict in Ukraine, though the death toll is small, is a drain on the country's resources which could be used to aid an already struggling economy. However, unlike the first two examples, the lasting effects of conflict on Ukraine's economy are still unknown. How will this conflict affect the productivity of the common working person in the short and long-run? We investigate precisely this effect.

Growth regressions do not typically include these destructive effects of war[1]. One exception is the work by Polachek and Sevastianova (2010) which investigates GDP per worker growth averages using independent variables of population growth, a central

[1] Barro (1989)

government's balanced budget, trade openness, investment, and interstate and intrastate conflict variables. The regressions are based on Sachs and Warner (1995) which augments standard Barro (1989) regressions to focus on the effect of natural resources.

Another way of doing growth empirics follows the approach by Mankiw et al. (1992). The Solow growth model is built on a production function of capital and labor to measure levels of gross domestic product. Mankiw et al. (1992) introduce human capital to the Solow model and find that human capital growth explains a great deal more of GDP variation than physical capital growth. It is from this approach that we measure how much conflict affects GDP per worker.

Beyond the empirical work in Polachek and Sevastianova (2010), very little empirical economic research into conflict exists. There are many different theories of conflict which are modeled in the context of game theory, but as Murdoch and Sandler (2002) write in their survey of empirical work related to civil war, there is a need for more "quantitative analysis to distinguish between theories". The problem is that there exists little theory of the effect of conflict on growth, as conflict theory usually looks at determinants of conflict[2].

To look at the relationship of conflict and growth we construct growth models similar to Polachek and Sevastianova (2010) and Mankiw et al. (1992) and introduce civil war and interstate war over short and long periods. The first group estimation is panel time-series in a generalized method of moments and instrumental variables

[2] For instance, Collier and Hoeffler (2004), Fearon and Laitin (2003), Lacina (2006) and Elbadawi (1999) determine the onset and severity of civil war.

framework, an expansion of more general empirical methods in Polachek and Sevastianova (2010). In the second estimation, we model GDP per worker with shares of investment, population growth, and conflict based on Mankiw et al. (1992). The first estimation is done as a point of comparison to estimation in ordinary least squares from Polachek and Sevastianova (2010) and to determine which type of conflict, interstate or intrastate, has a short and long-run effect. The second estimation determines how important conflict is in determining a worker's typical standard of living.

The results from the first group estimation indicate that interstate war, aggression across borders, causes a 0.56 percent decrease in GDP per worker per year of conflict over a 20-year average. This means that a country that has experienced 5 consecutive years of interstate conflict will have an annual growth rate that is 2.8 percentage points less growth than a country that is peaceful. This result must be considered in the context of an average growth rate that is between 1 and 2 percent. Separating the data by region we notice that Asian and Southeast Asian countries face slightly smaller declines in GDP due to civil war. Also, supporting the current conflict literature, conflict is relegated to low and middle-income countries.

The first group estimation is based on the specification of Polachek and Sevastianova (2010) and is preceded by the theory behind Sachs and Warner (1995), an explanation of the data and conflict variables, and empirical estimation methods. The results are reported by region and income and then finally as a whole. The second group estimation follows with an analysis of Mankiw et al. (1992) and a GDP levels estimation with conflict. The relationship between low income countries and conflict is addressed and followed by theory based on the Solow model of growth. Then the paper

concludes with data, methods and results for this second group estimation.

1.2 Literature review

Two mainstays in the economic conflict literature, Skaperdas and Garfinkel, draw on knowledge of game theory with applications to conflict; however, newer research empirically analyses the negative economic impact of conflict. Blomberg and Hess (2002) considered 152 countries from 1950-1992 and found that economic recessions generally promote internal and external conflict. They also concluded that the state of the economy and conflict are dependent on one another.

Sevastianova (2009) found a strong relationship between levels of GDP and conflict, but cautioned against using conflict with GDP growth. She explains that war may actually increase GDP with regards to international war. Polachek and Sevastianova (2010) find that both inter- and intra-state conflict reduce GDP growth, and severity matters more than duration of conflict. We will see that severity is indeed a better measure of conflict's deleterious effect, but the effect seldom appears to substantially increase GDP per worker.

Blattman and Miguel (2010) remind us of the need for better data and a more micro-oriented analysis of conflict. My analysis involves a macroeconomic perspective on conflict, but still achieves coherent and significant conclusions. Their case of analyzing conflict on the micro-level is further bolstered by the small effects of conflict on growth we will see country by country. We know conflict has damaging effects, its analysis may require more specific data on a micro-level. Another recent article from Nakamura et al. (2013) considers the implications of conflict on asset prices. Nakamura's research does not use conflict data from the Correlates of War or the

Uppsala Conflict Database which may further bolster any empirical take on conflict.

Murdoch and Sandler (2002) test a neoclassical growth model with civil war and the ensuing spillover effects on neighboring countries. They find results similar to Polachek and Sevastianova (2010) in which civil war has a strong short-run effect, but with collateral damage. They attribute spillover effects to reduced efficiency of resources such as a country spending more on military instead of other productive activities. Long-term effects of civil war are described as occurring as a result of destruction to human capital and forgoing investment. Murdoch and Sandler (2002) also echo the sentiments of Blattman and Miguel (2010) in the need for more “quantitative analysis to distinguish between theories”.

Since the dataset includes data from foreign aid recipients we should make mention of the relationship between aid and conflict. Chauvet (2003) concludes that violent instability has a positive effect on aid allocation and hence economic growth, but social instability has a negative effect. This suggests that countries which are experiencing conflict or war may actually receive more aid thus confusing the real deleterious effects of war on capital and labor. We contend that negative effects can still be seen in GDP growth rates despite the foreign aid influence.

The paper from which Polachek and Sevastianova (2010) base their estimation is Sachs and Warner (1995) wherein countries with high levels of natural resources are found not to experience high levels of economic growth. From this paper we use variables of investment, government efficiency, initial per capita incomes, etc. Sachs and Warner (1995) use long-run averages of GDP growth which are modified by Polachek and Sevastianova (2010) to include 1-year, 2-year and 5-year averages. In

this paper we consider a 10-year growth average as well. These growth regressions are also in the spirit of Barro (1989). Barro (1989) finds inverse relationships between growth and government consumption and initial levels of income. He also touches on the role of human capital which we will discuss in the specification by Mankiw et al. (1992).

Robert Solow's original growth model includes capital and labor while Mankiw et al. (1992) add human capital to better explain GDP per worker growth across countries. My second model stays true to Mankiw et al. (1992), though I add conflict to the capital and human capital accumulation equations. This is explained in greater detail in the following sections.

1.3 GDP per worker growth averages over different time periods via Polachek and Sevastianova (2010)

Generalized method of moments and instrumental variables estimation are based on Polachek and Sevastianova (2010) and Sachs and Warner (1995) who consider average growth rates covering 1970 to 1990. The Sachs and Warner model of 1995:

$$(\ln Y_{1990} - \ln Y_{1971})_i = \beta_0 + \beta_1 \ln Y_{1970i} + \beta_2' Z_i + \epsilon_i$$

Sachs and Warner (1995) use a base year of 1971 and find the average growth over 20 years. Polachek and Sevastianova (2010) take a more recent dataset and find variable growth rates. My empirical models are as follows and are analogous to the specification in Polachek and Sevastianova (2010) with the addition of a 10-year growth average:

$$\left(\ln Y_{it} - \ln Y_{it-j}\right)_i = \beta \ln Y_{0it} + \rho X_{it} + \varphi C_{it} + \alpha_i + \theta_t + \epsilon_i$$

$$j = 1, 2, 5, 10, 20$$

There is value added to these models by estimating with generalized method of moments via Arellano & Bond and instrumental variables. This accomplishes a check to the ordinary least squares regression techniques that Polachek and Sevastianova (2010) and Sachs and Warner (1995) employ. Y is GDP per worker and Y lagged by j years is GDP per worker from a previous period with a host of independent variables, X, and conflict variables, C, with group and period specific fixed effects. Sachs and Warner estimate with only 90 observations, 1 average growth rate per country. I replicate these results and then estimate a panel time-series in OLS and fixed effects.

1.4 Comprehensive data analysis for first group estimation

The data for this project come from the Penn World Tables (version 7.1 and 8.0), the Correlates of War database (version 4.0), the Sachs and Warner database (1997), and the World Development Indicators from the World Bank (2014). The Penn World Tables offer several definitions of gross domestic product, but to simplify estimation, I use GDP per employed person using version 7.1. The employment variable from version 8.0 has several missing values so I use the version 7.1 variable for better estimation efficiency. Using this definition of GDP, I derive 1-year, 5-year, 10-year and 20-year growth averages which are similar to Polachek's specification from Polachek and Sevastianova (2010).

From the Correlates of War database, I construct variables for war duration measured as the cumulative number of years in which a country experiences conflict. Polachek and Sevastianova (2010) uses a similar construction from the Correlates database for the years 1970 to 2000. This domestic war variable will explain not the

severity of war, but the cumulative effect of being engaged in conflict over one or many years. The example in Table 1 with civil war describes how this duration variable is accumulated.

The construction of the duration variable is to show the effect of cumulative engagement in conflict. The mean of the civil war duration variable is 0.172 years, as seen in Table 3, which tells us that any given country experiences about 2 months of civil conflict per year on average and half a month of interstate conflict for the respective interstate conflict duration variable.

To measure intensity of conflict, I take the variables of interstate and civil war battle deaths from the Correlates of War database. For a given year, conflict deaths per 1,000 people is measured for both specifications. The data is not precise for number of deaths occurring each year over time periods longer than 1 year. For example in Bosnia & Herzegovina, in Table 2, the conflict over a period of three years resulted in 27,500 casualties. However, the database does not list casualties incurred during the first year versus the last year of conflict, i.e. there is no variation in severity over the length of the civil war.

There are some inherent problems with this since the data collectors do not tally precise estimates of war casualties. However, this will still give coherent results and a general measure of conflict severity. This is one limitation of using a sizable dataset with many groups and periods - precise annual estimates of conflict have not been recorded for a duration longer than 1 year[3].

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[3] This is true with the exception of ACLED (Armed Conflict Location & Event Data Project).

Some criticism arises in that we consider GDP per worker, instead of GDP per capita. GDP per worker stays true to the original specification by Sachs & Warner, Polachek and Sevastianova (2010) and Mankiw et al. (1992). As a means of comparability of research, keeping GDP per worker will prove valuable and is supported by theory. Also, we mustn't account for deaths to the very young or elderly since they don't significantly contribute to GDP.

1.5 Stationarity vs. non-stationarity

There is still some dissension in explaining the stationarity of GDP. Nelson and Plosser (1982) could not reject the null hypothesis of a unit root and cautioned against the use of non-stationary monetary variables in explaining output variations. Aslanidis and Fountas (2012) found that only a few countries exhibit real GDP which is stationary and that the exchange rate regime has a role. Hegwood and Papell (2006) consider structural change when modelling real GDP and conclude it is in fact trend stationary in this context.

We may suspect non-stationarity in GDP per worker, but the test for a 10-year growth rate also suggests a unit root. Therefore, in the estimation procedure I difference the 10-year growth rates and achieve a desirable solution with significant coefficients. However, this solution actually yields a lower F-statistic and therefore suggests a poorer fit for GDP growth.

In Table 4, notice that the Maddala & Wu panel unit root test suggests unit roots in log GDP per worker and the 10-year GDP per worker growth variable. This procedure assumes cross-section independence of the dependent variable, but we may expect GDP per worker to be relatable across borders. GDP per worker will tend to rise over

time in all countries, however, this does not suggest a dependent relationship between countries.

The Pesaran panel unit root test assumes cross-section dependence, but for the reason I just mentioned, we wouldn't expect GDP growth rates to be related across countries except for the fact that they share a general positive trend. In summary, I maintain the undifferenced 10-year growth rates which provide a better explanatory model.

1.6 Robustness checks

An important consideration is whether we should study only countries which have experienced conflict or all countries as a whole. If we restrict the sample to only countries that have felt the effects of conflict through simply 25 deaths occurring in a year as a result of armed conflict, then the coefficients actually become smaller and less significant in the 1 and 2-year average regressions. In the 5-year and 10-year average regressions the coefficients are actually a bit larger, yet still less significant. The addition of several countries that have 0 values for conflict increases the sample size and therefore also the significance of coefficients. For the purposes of this paper, all countries are included in estimation unless otherwise specified.

Another issue is the exclusion of certain variables for which there are insufficient observations. The measure of central government budget balance, government revenue minus government expenditures, limits our sample to 140 countries with an average of 10.5 years of data per country. Excluding the variable includes 20 more countries in the sample with an average of 38.5 years of data per country. The F-statistic also increases from 42.01 to 52.74 in the 1-year average regressions using instrumental variables.

Thus the ratio of explained variance to unexplained variance without the central government budget balance is greater than with its inclusion and hence is a better explanatory model for short-run variations in GDP per worker. In the long-run, the generalized method of moments estimation fits a better model with the central government budget balance.

Multicollinearity may exist among the conflict variables as cumulative battle deaths are composed of interstate and civil war fatalities. If explanatory variables are related to each other than the coefficient estimates are unreliable and standard error estimates are too high. However, this is not the case as the variance inflation factors for civil war fatalities, interstate war fatalities and cumulative battle deaths are all below 5 which is the standard measure of degree for collinearity.

Another point of contention is the division of data into subsamples of income and region. Polachek and Sevastianova (2010) check results by region, income level and political regime while we only seek results by region and income. Some differences are noticeable by region and income; however, the overall conclusions are that conflict is a low and middle-income problem.

In Africa, from Tables 10 through 12, the duration of civil war and civil war fatalities play significant roles in growth. The strongest effects occur in the 10-year growth averages with a decline in GDP of 0.238 percent per year of civil war. With a 20-year average of 1.157 percent growth, this corresponds to significant drops to the average worker's well-being as civil war rages on.

The European story is similar with significant effects of civil war fatalities. A 10-year growth average is hindered by 0.935 percent for every 1,000 people that die in civil

conflict. Europe does not have any significant trouble with engaging in civil war in so far as no one dies and adversely affects the labor supply. High levels of human capital in Europe play a role in this context as valuable workers are killed or displaced.

Civil war has remarkable effects over all time periods in Asian and East Asian countries. In Tables 10 through 12, these countries exhibit significant 1, 2, and 5-year changes in growth of approximately 0.30 percent per year of civil war. Over the same time periods, Southeast Asian countries show slight improvements in growth as portions of their small labor force are replaced and the economy reorganizes. Interstate conflict plays a long-run role in Asia, in Table 14, with significant declines of 0.716 percent per year over a 20-year period.

Engagement in civil war in South America contributes to percentage changes in growth of roughly -0.5 percent per year of civil war over 2, 5, and 10-year periods in Tables 11 through 13. Prolonged civil war is always disadvantageous, but more so if civil conflicts do not resolve after 1 year. Weakening of Africa's economy occurs in the long-run at 10 and 20-year periods of growth. Engaging in civil war is costly to Africa in ways similar to South America.

1.7 Instrumental variables and GMM estimation

What is generalized method of moments estimation? Many economists are familiar with ordinary least squares estimation, but generalized method of moments estimation and its special case of instrumental variables estimation are fairly new topics. Generalized method of moments is a general estimation technique whereby estimators are determined from moment conditions. These moments may be the sample mean or variance and are used to estimate unknown parameters. We make assumptions about

the distribution of the population, such as that it is normally distributed, and from this assumption (and assumptions of the population mean and variance for example) we generate the sample moment conditions.

The number of moment conditions we specify, however, may not necessarily equal the number of parameters we wish to estimate and therefore we may not have exact solutions. In this case, the number of moment conditions we specify may be greater than the number of parameters we wish to find. The objective is then to minimize the differences between what we expect our parameters to be and the actual population values. GMM is useful in applications for large samples, such as my own, where the law of large numbers becomes beneficial.

Typically the GMM estimation technique via Arellano and Bond (1991) assumes limited to no serial correlation of the errors. The Wooldridge test for panel-data models from Wooldridge (2001) confirms no autocorrelation thus allowing the possibility of a consistent estimator. Arellano and Bond (1991) estimation is also typical with large N and small T (in my case, 59 groups and 10 years on average for 2-year, 5-year and 10-year growth averages). A simple autoregressive specification follows (from Arellano and Bond (1991)):

$$y_{it} = \alpha y_{i(t-1)} + \eta_i + v_{it}$$

The Arellano & Bond GMM estimation is included as a point of comparison to the instrumental variables, fixed effects regression technique called xtivreg2. I include and compare regression results from both specifications and only report the coefficients of interest on the conflict variables. This is done for 1-year, 2-year, 5-year and 10-year growth rates.

The method of IV/GMM estimation labeled “xtivreg2” is similar to the Arellano & Bond estimation technique. I chose to instrument the lag of GDP growth with lagged consumption prices. We expect correlation with consumption prices and GDP growth, but not necessarily with other variables. The improvement over estimation without instruments is very small and endogeneity in general shouldn’t pose a significant problem. Xtivreg2 estimates fixed-effects for panel time-series data and this estimation technique differs significantly from Polachek and Sevastianova (2010) in which panel fixed-effects estimation with OLS was completed.

Ordinary least squares is performed on all models and these types of regressions do not incorporate within-group variation of independent variables. This was a favored technique twenty years ago in growth models when long-period averages were simply calculated for each country in the sample. This method works perfectly fine when each country has one observation of interest, but panel time-series estimation may require us to include inherent differences in each country. Therefore, we include fixed effects estimation with group and period-specific effects to capture the innate differences among countries.

One question may be raised, “Why compare GMM estimation techniques with typical IV estimation?” Generalized method of moments estimation can account for arbitrary heteroscedasticity within groups - a problem which may arise in implementation of instrumental variable estimation. We may suspect some correlation of errors within groups, but using both techniques will be useful as a point of comparison. There is a tradeoff in efficiency by choosing not to use OLS and we’re allowing for this tradeoff. Also, we’re generally searching for some consistency with Polachek and

Sevastianova (2010) and conflict variables should be able to withstand such a comparison.

1.8 Results

In the regression analysis, some variables are omitted due to insignificance, otherwise the regressions are analogous to the specification in Polachek and Sevastianova (2010). Some of these are variables like measures of polity, institutional quality, and government consumption and other conflict variables such as militarized disputes. The addition of militarized disputes is problematic as the estimations in Polachek and Sevastianova (2010) excessively high changes in growth from these key variables. The interpretation of MIDs is also not straightforward as the variable is a discrete variable measuring the escalation of conflict.

The first two columns in Table 5 report results from Sachs & Warner's original dataset and my new dataset with variables that may differ slightly from the original set. Several of the key independent variables are actually averages over the time period of 1970 to 1990 and include 1 observation for each country. The second two columns report coefficients for panel time-series estimation in ordinary least squares without conflict and with conflict.

First, the results in Table 5 bear resemblance to the original. The 20-year growth rates are explained by all four conflict variables significantly. The addition of conflict yields striking results for countries that engage in long-periods of interstate war - a decline in GDP per worker of 0.56 percent over a period of 20-years for each year engaged in aggression across borders. For each year of civil war, there is an associated decline of 0.067 percent. Every 1,000 people killed by civil war result in loss to GDP of

0.029 percent. Once again, the mean of the dependent variable in Table 3 is 1.157 percent.

Short-run estimation in Tables 6 and 7 yield negative coefficients on interstate war fatalities per 1,000 people. The interpretation of these coefficients is such that a 1-unit increase in the conflict variable causes a percentage change in the dependent variable that is equal to the coefficient. Therefore, consecutive years of interstate war have a compounding effect on 1-year GDP growth rates. This is because if a country experiences 3-years of uninterrupted across the border conflict, then the effect on GDP growth can be 3-fold. A long-run interstate conflict can have lasting effects on annual and biennial GDP taking a greater toll with each additional year.

Growth rates over longer periods of time show the effects of conflict quite clearly. For the 5-year growth rates in Table 8, civil war duration and interstate fatalities play leading roles. Civil war's devastating effects are greater than interstate war's effects over 5-years. For every year a country is involved in civil war, there is an associated decline of about 0.144 percent in gross domestic product per worker.

Civil war and interstate war duration have roughly equal effects in the economy over 10 year periods in Table 9. Interstate war fatalities still play a small role as the labor supply is reduced. Overall, we cannot make a judgement on whether civil war or interstate war is more damaging, but we do discover some overall trends. Civil war does not affect GDP growth in the short run over 1 to 2-year periods. It is a 5 to 20-year problem creating lasting effects in an economy. Interstate war has a small effect in the short-run and large effect in the long-run. The 20-year growth rate average suffers the most from prolonged periods of interstate war engagement.

1.9 GDP levels estimation via Mankiw et al. (1992)

1.9.1 Introduction

Mankiw et al. (1992) propose an augmented model of Solow's neoclassical production function of capital and labor. The inclusion of human capital in the production function provided more empirical evidence of the Solow theory which explains cross-country variations in income per capita. This paper reaffirms Solow's predictions by updating the model with current data and fixed-effects regression techniques. Then, the addition of conflict into the model provides a framework for analyzing the share of destructive war in determining the standard of living.

Research into conflict has often described conflict as a low-income country problem. This is evident in the scatter diagram in Figure 3 of logged gross domestic product per worker over the period 1960 to 2011 and civil war deaths per 1,000 people. The severity of war is measured by the number of deaths and we see that extreme examples of conflict typically occur in low-income countries. The Khmer Rouge in Cambodia are responsible for close to 45,000 deaths and the Bosnian civil war of the 1990s accounts for almost 30,000 deaths. The U.S. was involved in civil war and experienced casualties in Vietnam in the early 1960s before the Vietnam War, however, these deaths measured in the hundreds.

There is a clear relationship between economic level of well-being and conflict, but how much of this well-being is determined by destructive activity?

1.9.2 Theory

Mankiw et al. (1992) specifically address the Solow model of growth with the addition of human capital. From this model I introduce conflict into the capital and

human capital accumulation equations. The literature suggests such capital destruction along with labor displacement, but I account for declines in labor through human capital.

The Mankiw et al. (1992) specification is as follows:

$$Y_t = K_t^{\alpha} H_t^{\beta} (A_t L_t)^{(1-\alpha-\beta)}$$

The basic theoretical model defines Y_t as GDP, K_t as capital, L_t as labor, H_t as human capital, and A_t as the level of technology all at time t. This specification differs only from the Solow Model in that it includes H_t^{β} as a measure of human capital and hence a β is subtracted from the A_tL_t exponent. The model I propose is identical in this respect, yet through the accumulation of capital and human capital, conflict has a disastrous effect. The capital and human capital accumulation equations are:

$$\dot{K}_t = s_K Y_t - \delta K_t - cK_t$$

$$\dot{H}_t = s_H Y_t - \delta H_t - cH_t$$

Mankiw et al. (1992) hypothesize a rate of capital depreciation, δ, at 0.03 and g, the growth of technology, at about 0.02. The depreciation of capital due to conflict is somewhat more difficult to measure. There exists no real, accurate measure of the declines in capital due to war. However, we will discover this does not pose a significant problem. If we divide (1) by A_tL_t to get a measure of per worker GDP, capital and human capital, then the production function becomes:

$$y_t = k_t^{\alpha} h_t^{\beta}$$

Solving for the change in capital and human capital over time we discover that destruction of capital will play a role similar to population growth, technology growth, and depreciation:

$$\dot{k}_t = s_K y_t - k_t[\eta + g + \delta + c]$$

$$\dot{h}_t = s_H y_t - h_t[\eta + g + \delta + c]$$

In steady-state, $\dot{k}_t = \dot{h}_t = 0$, and we find expressions for physical capital and human capital, k^* and h^*:

$$k^* = \frac{s_K}{\eta + g + \delta + c}^{\frac{1-\beta}{1-\alpha-\beta}} \frac{s_H}{\eta + g + \delta + c}^{\frac{\beta}{1-\alpha-\beta}}$$

$$h^* = \frac{s_H}{\eta + g + \delta + c}^{\frac{1-\alpha}{1-\alpha-\beta}} \frac{s_K}{\eta + g + \delta + c}^{\frac{\alpha}{1-\alpha-\beta}}$$

Then solving for y^*, the steady-state value of GDP per worker, as a function of the right-hand side of equations (7) and (8):

$$y^* = \frac{s_K}{\eta + g + \delta + c}^{\frac{\alpha}{1-\alpha-\beta}} \frac{s_H}{\eta + g + \delta + c}^{\frac{\beta}{1-\alpha-\beta}}$$

For the empirical specification we must take natural logs of all variables and separate the technology parameter from GDP per worker. The technology parameter is determined by an initial level, A(0), and exogenous growth rate, g_t, in $A_t = A(0)e^{gt}$. The form of our empirical model:

$$\ln\left[\frac{Y_t}{L_t}\right] = \ln A(0) + g_t + \frac{\alpha}{1-\alpha-\beta}\ln(s_K) + \frac{\beta}{1-\alpha-\beta}\ln(s_H) - \frac{\alpha+\beta}{1-\alpha-\beta}\ln(\eta + g + \delta + c)$$

The model in Mankiw et al. (1992) expresses human capital alternatively in levels by combining (7) and (10). Income per worker is now expressed as a function of the rate of investment, human capital, and the rate of population growth and capital destruction due to conflict:

$$\ln\left[\frac{Y_t}{L_t}\right] = \ln A(0) + g_t + \frac{\alpha}{1-\alpha}\ln(s_K) + \frac{\beta}{1-\alpha}\ln(h^*) - \frac{\alpha}{1-\alpha}\ln(\eta + g + \delta + c)$$

1.9.3 Data

The measure of human capital comes from Penn World Tables version 8.0 which compiles years of schooling from Barro and Lee (2013) and returns to education from Psacharopoulos (1993). The Barro and Lee (2013) dataset includes census and survey observations from UNESCO, statistic agencies, and other sources for educational attainment of individuals over 15 years of age. Psacharopoulos' rate of return on education takes into account benefits and costs of education, i.e. earnings and foregone earnings for attending school.

The population growth variable also comes from version 8.0 of Penn World Tables and includes individuals of all ages, not only those of working age. This is a deviation from Mankiw et al. (1992) due to the desire for longer periods of consistent data and estimation efficiency. The regressions still yield similar results to Mankiw et al. (1992) in light of this substitution.

The conflict variables are measures of duration and severity for both interstate and intrastate conflict from the Correlates of War database versions 4.1 and 4.0 respectively. We may not take natural logs of this data due to the prevalence of many values of 0 during a period of peace, therefore the interpretation of coefficients from the regressions is not one of elasticity. A share of gross domestic product per worker is still determined by these conflict variables and is discussed in more detail in the results section.

Gross domestic product per worker is measured in 2005 constant prices from Penn World Tables version 7.1. Version 8.0 includes separate variables for GDP and employment, but the 7.1 version is used to avoid discrepancies and missing

employment data. This variable corresponds to both dependent variable specifications by Polachek and Sevastianova (2010) and Mankiw et al. (1992).

1.9.4 Results

The original model by Mankiw et al. (1992) consists of samples from OECD countries, non-oil producing countries, and countries with populations less than 1 million and having poor data. I've restricted my analysis to OECD, Non-oil producing and all countries because poor data quality should not be the problem as the original paper was published over 20 years ago. The estimation procedure is ordinary least squares and the results are recorded in Table 18. The first two columns are coefficients resulting from Mankiw et al. (1992). The independent variables are average investment and average population growth from 1960 to 1985. Solow theory predicts that coefficients for investment and population growth are 0.50 and -0.50 and this is true for OECD countries. The non-oil producing countries have larger coefficients than are otherwise predicted - a problem resolved in Mankiw et al. (1992) with the addition of human capital.

The Mankiw et al. (1992) results are included with updated data from 1960 to 2010 as a point of comparison. The Solow model does not seem to hold up with the inclusion of new OECD countries and a longer time period and the non-oil countries give us the same problem of inappropriately large coefficients. The support for the Solow model improves in the panel time-series analysis in Table 19. Comparing OLS and fixed effects estimation results we notice smaller coefficients with higher significance.

The inclusion of human capital allows for a better fit of the data. Table 20 shows

just how much human capital explains logged GDP per worker. Mankiw et al. (1992) find greater coefficients on human capital for OECD countries and Table 20 tells just the opposite story. There are some new OECD countries included in the sample and human capital may play less of a role than it did 30 years ago in determining GDP. Human capital matters to non-oil producing countries with coefficients of 2.89 compared to 1.49 of OECD countries. The dependent variables, in Table 3, have means between 9 and 10. The interstate war variable, as suspected, does not affect OECD countries in Tables 20 and 21.

Conflict as previously noted is a low to middle-income country problem as evidenced in Tables 15 though 18. Still in the ordinary least squares regressions we don't receive consistently significant coefficients. The fixed effect estimations in Table 21 are better suited for analysis in contrast to Table 20. The GDP of OECD countries is well-explained through human capital and the coefficients are not inappropriately large. All coefficients are of the correct sign and statistically significant. The interstate conflict variable for non-oil producing countries accounts for almost the exact same share of GDP as the population growth rate. Therefore, in terms of explanatory power, conflict's destructive effects seem to account for the same decline in GDP as the population growth rate.

1.10 Conclusion

The natural resource model from Sachs and Warner (1995) and the revision by Polachek and Sevastianova (2010) provide an empirical base from which we analyze conflict's deleterious effect on GDP growth per worker. Using GMM estimation techniques we arrive at conclusions similar to Polachek and Sevastianova (2010), but

with the distinct differences between interstate and civil war in the short and long-run. Civil war has lasting effects in an economy, over 5 and 10 years, with no short-run effect to the average worker's standard of living. Interstate war has small effects in the short-run, over 1 and 2-year periods, but larger effects over 20-year periods. The decline in GDP per worker is as much as 0.56 percent per year of interstate conflict.

The inclusion of conflict in the Mankiw et al. (1992) augmented Solow model proves insightful theoretically and empirically. The disastrous effect of conflict represents as much of the share of GDP as Solow's original population growth variable. The Solow model is also better analyzed through fixed effects panel time-series estimation than ordinary least squares.

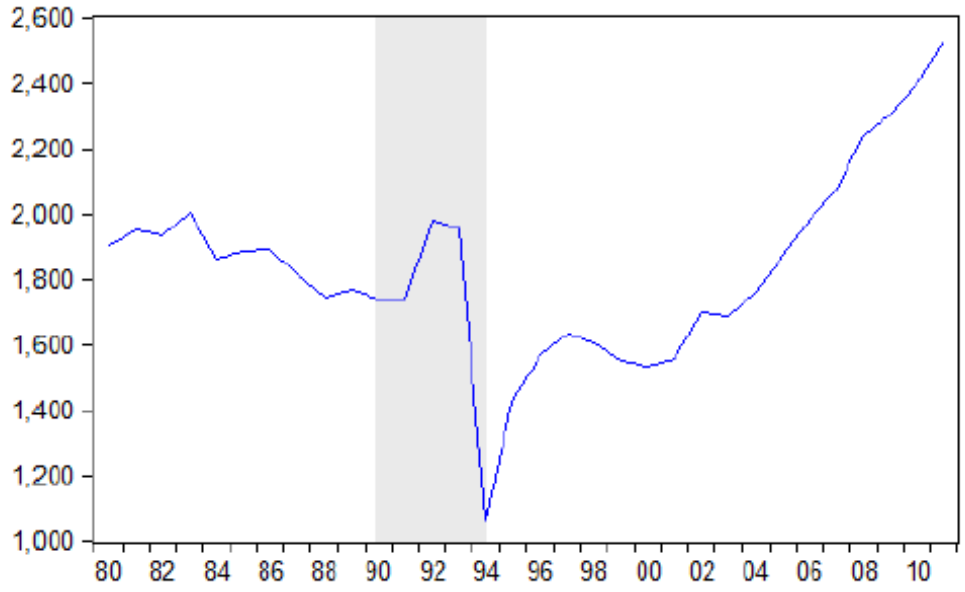

Figure 1: Real GDP per worker in Rwanda 1960-2011

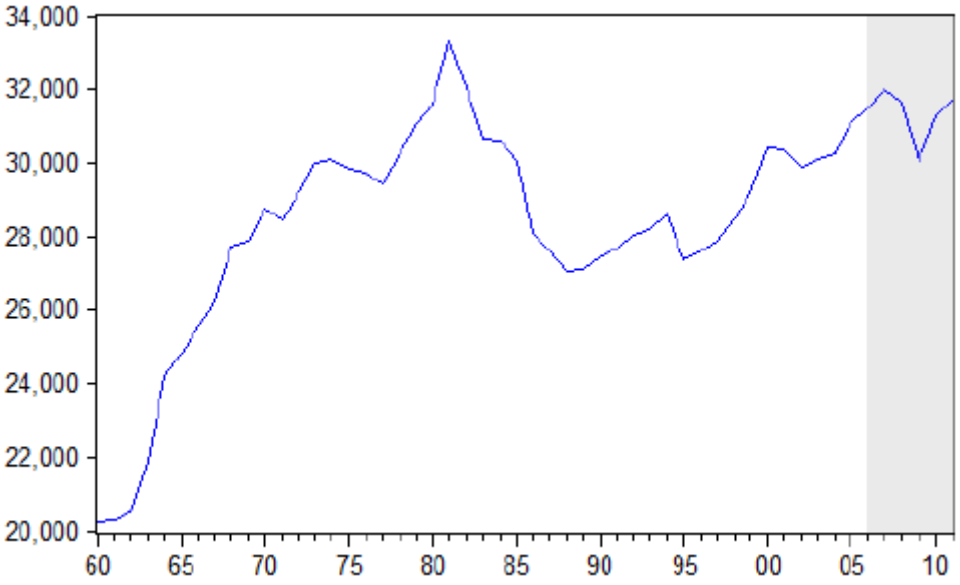

Figure 2: Real GDP per worker in Mexico 1960-2011

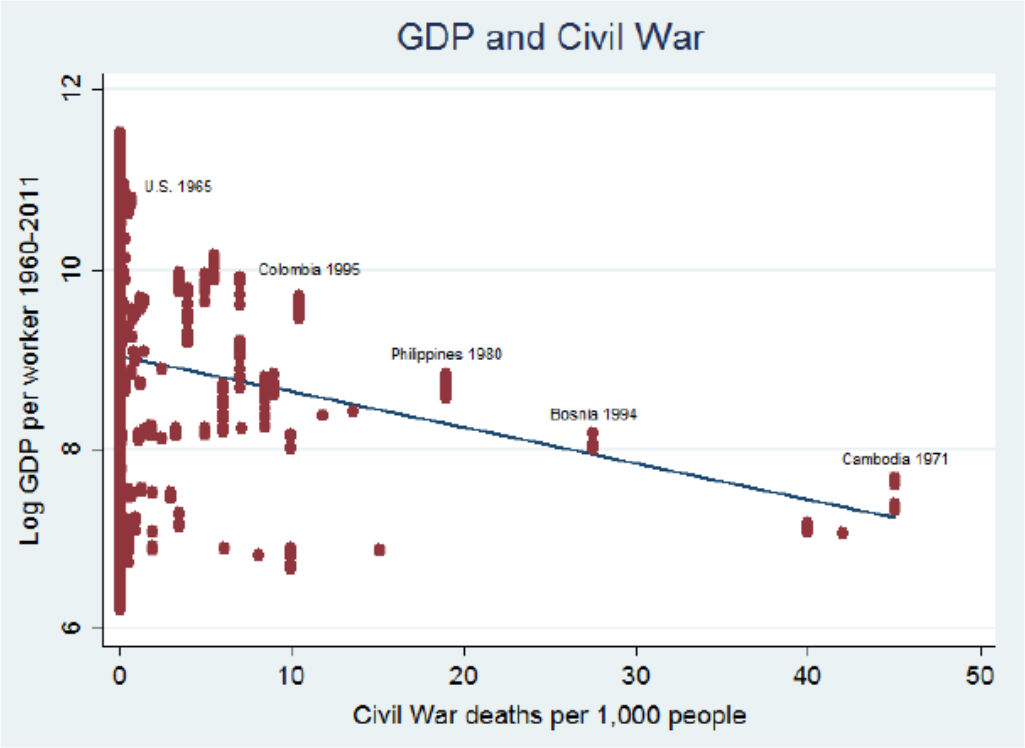

Figure 3: Log GDP per worker and civil war deaths 1960-2011

Table 1: Civil war's duration

Bosnia & Herzegovina	1990	1991	1992	1993	1994	1995
Civil War Duration	0	0	1	2	3	0

Note: This measures cumulative years engaged in conflict.

Table 2: Civil war's severity

Bosnia & Herzegovina	1990	1991	1992	1993	1994	1995
Civil War Deaths per 1,000	0	0	27.5	27.5	27.5	0

Note: This measures total combatant battle deaths per 1,000 people.

Table 3: Summary statistics

Variable	Mean	Std. Dev.	N	Source	Description
GDP_log_1yr	0.007	0.203	6657	Penn World Table	Average growth rate of real GDP per worker
GDP_log_lag	9.367	1.203	6760	Penn World Table	The log lag of real GDP per worker
GDP_worker_log	9.506	1.283	5052	Penn World Table	Log of PPP GDP per person in total employment at 2005
Inv	22.993	11.382	8121	Penn World Table	Log of Investment Share of PPP Converted GDP Per Capita in 2005
Emp_log	0.791	0.983	5722	Penn World Table	Log of Employment Growth
hc	2.119	0.623	6196	Penn World Table	Index of human capital per person, based on years of schooling
t	26.5	15.009	10972	Own Dataset	Time trend
Ctfp	1.016	1.293	2307	Penn World Table	TFP level at current PPPs (USA=1)
pop_growth	27.516	1607.835	7524	Penn World Table	Growth of Population (in millions)
Grpop	-6.915	505.864	6704	Penn World Table	Employment Growth - Population Growth
open	76.727	49.025	8131	Penn World Table	Openness at 2005 constant prices (%)
cgb	0.02	8.023	1960	World Development Indicators	Government Revenue - Government Expense
Sxp	0.232	0.271	7568	Penn World Tables	Share of merchandise exports at current PPPs
exlife	62.967	11.537	10074	World Development Indicators	Life expectancy at birth, total (years)
trade	77.332	49.394	7519	World Development Indicators	Trade (% of GDP)
exlifesqr	4097.985	1376.649	10074	World Development Indicators	Square of average life expectancy
openinteract	715.833	535.471	6391	Penn World Table	"open" x "GDP_log_lag"
tropics	0.253	0.423	11128	Sachs & Warner	Share of tropical climate
Civil War Duration	0.172	1.235	11128	Correlates of War	# of years engaged in civil war
Interstate War Duration	0.046	0.482	10972	Correlates of War	# of years engaged in interstate war
Civil War deaths per 1000	0.206	1.923	10972	Correlates of War	# of civil war deaths per 1,000 people
Interstate War deaths per 1000	1.399	27.105	10972	Correlates of War	# of interstate war deaths per 1,000 people
General Conflict duration	3.278	7.769	4056	Uppsala Conflict Database	# of years engaged in conflict ending in 25 deaths
Cumulative Battle deaths per 1000	9.635	167.029	10972	Correlates of War	Severity measure of cumulative deaths
Tropical Conflict duration	1.274	5.041	4056	Penn & Uppsala	# of years engaged in conflict in tropics

Table 4: Panel unit root tests

	Lags	Maddala & Wu w/o trend	Maddala & Wu w/ trend	Pesaran w/o trend	Pesaran w/ trend
Log GDP per worker	0	0.000	0.999	0.994	0.987
	1	0.000	0.879	0.997	0.999
Log GDP/worker 1-yr growth	0	0.000	0.000	0.000	0.000
	1	0.000	0.000	0.000	0.000
Log GDP/worker 2-yr growth	0	0.000	0.000	0.000	0.000
	1	0.000	0.000	0.000	0.000
Log GDP/worker 5-yr growth	0	0.000	0.006	0.203	0.972
	1	0.000	0.000	0.000	0.033
Log GDP/worker 10-yr growth	0	0.000	1.000	0.990	1.00
	1	0.000	0.972	0.907	1.00

Null hypotheses: series are I(1)

Maddala & Wu assumes cross-section independence

Pesaran assumes cross-section dependence

Table 5: 20-year percent change in GDP per worker

	(1970-1990) (S&W Original)	(1970-1990) S&W New	(1960-2011) OLS	(1960-2011) OLS w/conflict
lagged income	**-1.536*****	**-1.022*****	**-0.883*****	**-1.006*****
(Laglngdp)	(0.237)	(0.2414)	(0.0710)	(0.0743)
openness index	**7.322***	**11.811*****	**4.077*****	**3.409*****
(Open)	(2.859)	(4.236)	(0.921)	(0.916)
openness index*lagged income	-0.586	**-1.082****	**-0.430*****	**-0.358*****
(Open*Laglngdp)	(0.341)	(0.4420)	(0.102)	(0.102)
Tropics	**-1.113*****	**-0.8437*****	**-0.674*****	**-0.540*****
(Tropics)	(0.285)	(0.3956)	(0.115)	(0.116)
landlocked	**-0.610***	-.4004	-0.0437	-0.0401
(Access)	(0.263)	(0.4428)	(0.131)	(0.130)
Government budget balance	**0.133*****			
(Cgb)	(0.0222)			
population growth	**1.142****	-0.0516	**-0.0576****	**-0.0552****
(Grpop)	(0.360)	(0.2770)	(0.0212)	(0.0209)
primary product exports	**-3.574*****	**2.547***	**2.446*****	**2.318*****
(Sxp)	(1.009)	(1.335)	(0.244)	(0.242)
life expectancy	16.23	0.0913	**0.191****	**0.190****
(Exlife)	(19.99)	(0.1633)	(0.0603)	(0.0598)
life expectancy squared	-1.586	0.0000	-0.000546	-0.000441
(Exlifesqr)	(2.562)	(0.0015)	(0.000522)	(0.000518)
civil war duration				**-0.0666****
				(0.0247)
interstate war duration				**-0.555****
				(0.178)
civil war fatalities				**-0.0286***
				(0.0144)
interstate war fatalities				**0.00611*****
				(0.00140)
Constant	-25.27	-3.298	-0.252	0.463
	(39.03)	(1.995)	(1.736)	(1.730)
Observations	90	98	1207	1207
R-squared	0.8252	0.4100	0.3301	0.3517

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 6: 1-year percent changes in GDP per worker

	(OLS) GDP_1yr	(xtreg) GDP_1yr	(xtivreg2) GDP_1yr	(xtabond) GDP_1yr
CivilWarDur	-0.178	-0.214	-0.214	-0.109
	(0.0922)	(0.117)	(0.117)	(0.257)
InterstateDur	-0.0113	-0.190	-0.190	-0.192
	(0.209)	(0.222)	(0.221)	(0.371)
CivilWar_1000	0.00635	0.0482	0.0482	0.0570
	(0.0511)	(0.0597)	(0.0596)	(0.104)
InterstateWar_1000	**-0.00812**••	**-0.00907**••	**-0.00907**••	**-0.0112**•
	(0.00282)	(0.00330)	(0.00329)	(0.00483)
Observations	2055	2055	2055	1953

Standard errors in parentheses

• $p < 0.05$, •• $p < 0.01$, ••• $p < 0.001$

Table 7: 2-year percent changes in GDP per worker

	(OLS) GDP_2yr	(xtreg) GDP_2yr	(xtivreg2) GDP_2yr	(xtabond) GDP_2yr
CivilWarDur	-0.128	-0.145	-0.145	-0.0797
	(0.0702)	(0.0858)	(0.0855)	(0.139)
InterstateDur	0.131	-0.0199	-0.0199	0.0111
	(0.159)	(0.163)	(0.162)	(0.200)
CivilWar_1000	-0.0226	0.0187	0.0187	0.0422
	(0.0389)	(0.0438)	(0.0437)	(0.0558)
InterstateWar_1000	**-0.00870**•••	**-0.00859**•••	**-0.00859**•••	-0.00125
	(0.00215)	(0.00242)	(0.00242)	(0.00265)
Observations	2051	2051	2051	1949

Standard errors in parentheses

• $p < 0.05$, •• $p < 0.01$, ••• $p < 0.001$

Table 8: 5-year percent changes in GDP per worker

	(OLS) GDP_5yr	(xtreg) GDP_5yr	(xtivreg2) GDP_5yr	(xtabond) GDP_5yr
CivilWarDur	**-0.119***	**-0.144****	**-0.144****	-0.00637
	(0.0479)	(0.0536)	(0.0535)	(0.0663)
InterstateDur	0.153	-0.0330	-0.0330	0.176
	(0.108)	(0.102)	(0.102)	(0.0930)
CivilWar_1000	-0.0397	-0.0149	-0.0149	0.0273
	(0.0266)	(0.0274)	(0.0274)	(0.0264)
InterstateWar_1000	**-0.00972*****	**-0.0119*****	**-0.0119*****	**-0.00419****
	(0.00147)	(0.00153)	(0.00153)	(0.00129)
Observations	2039	2039	2039	1936

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 9: 10-year percent changes in GDP per worker

	(OLS) GDP_10yr	(xtreg) GDP_10yr	(xtivreg2) GDP_10yr	(xtabond) GDP_10yr
CivilWarDur	**-0.111****	**-0.145*****	**-0.145*****	-0.0395
	(0.0365)	(0.0342)	(0.0341)	(0.0352)
InterstateDur	0.0552	**-0.154***	**-0.154***	0.106*
	(0.0828)	(0.0653)	(0.0652)	(0.0491)
CivilWar_1000	**-0.0501***	**-0.0408***	**-0.0408***	0.00750
	(0.0203)	(0.0175)	(0.0175)	(0.0137)
InterstateWar_1000	**-0.00649*****	**-0.00787*****	**-0.00787*****	**-0.00358*****
	(0.00112)	(0.00101)	(0.00101)	(0.000700)
Observations	2013	2013	2013	1838

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 10: 1-year percent changes by region

	(OLS) Africa	(OLS) Europe	(OLS) Asia	(OLS) ASEAN	(OLS) S.America	(OLS) N.America
CivilWarDur	0.0145	0.196	-0.346	**-0.307****	-0.479	-0.881
	(0.199)	(0.510)	(0.193)	(0.0942)	(0.306)	(0.828)
InterstateDur	-1.622	-3.538	-0.104	-0.284	0	0.897
	(1.342)	(2.874)	(0.410)	(0.578)	(.)	(1.985)
CivilWar_1000	-0.0309	-1.015	0.217	0.213	-0.124	1.420
	(0.0624)	(0.748)	(0.180)	(0.123)	(0.302)	(3.053)
InterstateWar_1000	-0.0459	-9.357	-0.00846	2.657	0	-0.109
	(0.793)	(5.095)	(0.00475)	(5.023)	(.)	(0.259)
Observations	676	457	378	115	206	246

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 11: 2-year percent changes by region

	(OLS) Africa	(OLS) Europe	(OLS) Asia	(OLS) ASEAN	(OLS) S.America	(OLS) N.America
CivilWarDur	0.0949	0.125	**-0.317***	**-0.306*****	**-0.507***	-1.063
	(0.148)	(0.413)	(0.136)	(0.0742)	(0.255)	(0.648)
InterstateDur	-1.015	-1.513	0.0699	-0.518	0	0.707
	(0.997)	(2.326)	(0.290)	(0.455)	(.)	(1.554)
CivilWar_1000	-0.0709	-0.569	0.227	**0.255****	-0.0439	2.242
	(0.0464)	(0.605)	(0.127)	(0.0971)	(0.251)	(2.390)
InterstateWar_1000	0.241	-6.635	**-0.00835***	3.901	0	-0.0959
	(0.590)	(4.124)	(0.00335)	(3.956)	(.)	(0.203)
Observations	676	454	377	115	206	246

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 12: 5-year percent changes by region

	(OLS) Africa	(OLS) Europe	(OLS) Asia	(OLS) ASEAN	OLS) S.America	(6) N.America
CivilWarDur	-0.118	0.216	**-0.277*****	**-0.297*****	**-0.576*****	-0.564
	(0.0999)	(0.273)	(0.0828)	(0.0444)	(0.171)	(0.489)
InterstateDur	0.0534	-0.800	-0.0196	-0.116	0	-0.169
	(0.672)	(1.534)	(0.176)	(0.273)	(.)	(1.172)
CivilWar_1000	**-0.0753***	**-0.989***	0.146	**0.198*****	0.177	1.454
	(0.0313)	(0.399)	(0.0774)	(0.0582)	(0.169)	(1.803)
InterstateWar_1000	0.0667	-1.780	**-0.0100*****	-0.257	0	0.0113
	(0.397)	(2.719)	(0.00204)	(2.369)	(.)	(0.153)
Observations	676	445	374	115	206	246

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 13: 10-year percent changes by region

	(OLS) Africa	(OLS) Europe	(OLS) Asia	(OLS) ASEAN	(OLS) S.America	(OLS) N.America
CivilWarDur	**-0.238*****	0.00667	**-0.250*****	**-0.278*****	**-0.490*****	-0.384
	(0.0712)	(0.194)	(0.0587)	(0.0272)	(0.108)	(0.351)
InterstateDur	-0.367	0.0711	-0.241	0.314	0	-0.0189
	(0.516)	(1.087)	(0.125)	(0.167)	(.)	(0.840)
CivilWar_1000	**-0.0743*****	**-0.935****	**0.133***	0.0291	0.0695	1.510
	(0.0223)	(0.283)	(0.0551)	(0.0356)	(0.107)	(1.293)
InterstateWar_1000	0.245	-0.376	**-0.00554*****	**-4.257****	0	0.00367
	(0.286)	(1.926)	(0.00145)	(1.452)	(.)	(0.110)
Observations	670	430	369	115	206	246

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 14: 20-year percent changes by region

	(OLS) Africa	(OLS) Europe	(OLS) Asia	(OLS) ASEAN	(OLS) S.America	(OLS) N.America
CivilWarDur	**-0.171****	0.182	**-0.200*****	**-0.200*****	**-0.357*****	-0.363
	(0.0517)	(0.257)	(0.0352)	(0.0123)	(0.0436)	(0.284)
InterstateDur	-0.847	-0.262	**-0.716*****	0	0	-0.387
	(1.344)	(0.932)	(0.137)	(.)	(.)	(0.974)
CivilWar_1000	-0.0233	**-0.600***	**0.167*****	0.0210	**0.0885***	2.825*
	(0.0158)	(0.250)	(0.0480)	(0.0213)	(0.0435)	(1.234)
InterstateWar_1000	1.092	-2.799	**0.00970*****	0	0	0
	(2.318)	(5.110)	(0.00118)	(.)	(.)	(.)
Observations	455	230	210	65	117	143

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 15: Low income percent changes in GDP per worker

	(OLS) 1yr	(OLS) 2yr	(OLS) 5yr	(OLS) 10yr	(OLS) 20yr
CivilWarDur	-0.0604	0.0385	-0.118	**-0.220*****	**-0.128*****
	(0.200)	(0.138)	(0.0848)	(0.0527)	(0.0355)
InterstateDur	-2.053	-2.467	0.950	-0.696	-0.269
	(3.536)	(2.451)	(1.501)	(0.934)	(1.481)
CivilWar_1000	-0.0197	-0.0607	**-0.0614***	**-0.0603*****	-0.0191
	(0.0629)	(0.0436)	(0.0267)	(0.0166)	(0.0109)
InterstateWar_1000	-1.555	0.629	-1.920	-0.0819	0.0768
	(4.092)	(2.836)	(1.737)	(1.081)	(2.346)
Observations	402	402	402	402	288

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 16: Middle income percent changes in GDP per worker

	(OLS) 1yr	(OLS) 2yr	(OLS) 5yr	(OLS) 10yr	(OLS) 20yr
CivilWarDur	**-0.344***	**-0.327****	**-0.266*****	**-0.221*****	**-0.124*****
	(0.146)	(0.110)	(0.0722)	(0.0526)	(0.0365)
InterstateDur	-0.0712	0.0866	0.0465	-0.163	**-0.635*****
	(0.335)	(0.252)	(0.166)	(0.121)	(0.173)
CivilWar_1000	0.175	0.171	**0.141***	**0.114***	0.0815
	(0.128)	(0.0966)	(0.0639)	(0.0468)	(0.0436)
InterstateWar_1000	**-0.00855***	**-0.00915****	**-0.00975*****	**-0.00559*****	**0.00617*****
	(0.00374)	(0.00281)	(0.00185)	(0.00135)	(0.00136)
Observations	942	940	934	918	536

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 17: High income percent changes in GDP per worker

	(OLS) 1yr	(OLS) 2yr	(OLS) 5yr	(OLS) 10yr	(OLS) 20yr
CivilWarDur	0.321	0.453	0.392	0.312	0.346
	(0.621)	(0.508)	(0.373)	(0.292)	(0.611)
InterstateDur	-0.0632	0.0658	0.114	0.0688	-0.783
	(0.313)	(0.256)	(0.188)	(0.148)	(1.238)
CivilWar_1000	-4.470	-6.964	-4.509	-2.601	-1.541
	(6.819)	(5.583)	(4.102)	(3.212)	(5.145)
InterstateWar_1000	0.00619	-0.0161	-0.0233	-0.00885	3.906
	(0.0537)	(0.0439)	(0.0323)	(0.0253)	(3.852)
Observations	711	709	703	693	383

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 18: Original and current Mankiw regressions with average investment and population growth

	(Log GDP/emp 1985) OECD	(Log GDP/emp 1985) Non-Oil	(Log GDP/emp 2010) OECD	(Log GDP/emp 2010) Non-Oil
Average Investment	0.530	**0.920*****	0.699	**1.220*****
	(0.276)	(0.182)	(0.353)	(0.187)
Average Pop. Growth	-0.527	**-3.596*****	0.00828	**-2.671*****
	(0.499)	(0.555)	(0.455)	(0.453)
Constant	**7.579*****	-2.851	**8.777*****	-1.297
	(1.420)	(1.439)	(1.643)	(1.268)
Observations	22	96	34	148

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 19: OLS and fixed-effects regressions using panel time-series 1960-2011

	(Log GDP/emp) (OLS) OECD	(Log GDP/emp) (OLS) Non-Oil	(Log GDP/emp) (Fixed effects) OECD	(Log GDP/emp) (Fixed effects) Non-Oil
Log Investment	**0.343*****	**1.002*****	0.0523	**0.160*****
	(0.0553)	(0.0306)	(0.0667)	(0.0147)
Log Pop. Growth	**-0.221*****	**-0.735*****	**-0.171*****	**-0.126*****
	(0.0321)	(0.0401)	(0.0239)	(0.0120)
Constant	**9.001*****	**4.340*****	**10.05*****	**8.483*****
	(0.192)	(0.135)	(0.221)	(0.0542)
Observations	1099	4776	1099	4776

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 20: OLS regressions with current OECD, non-oil, and all countries from 1960-2011 with and without conflict inclusive human capital

	(Log GDP/emp) (OLS) OECD	(Log GDP/emp) (OLS) Non-Oil	(Log GDP/emp) (OLS) All	(Log GDP/emp) (OLS) OECD	(Log GDP/emp) (OLS) Non-Oil	(Log GDP/emp) (OLS) All
hc_log	**1.486*****	**2.891*****	**2.818*****	**1.486*****	**2.892*****	**2.817*****
	(0.0551)	(0.0397)	(0.0408)	(0.0553)	(0.0396)	(0.0408)
Inv_log	**0.373*****	**0.393*****	**0.424*****	**0.373*****	**0.391*****	**0.424*****
	(0.0434)	(0.0215)	(0.0217)	(0.0434)	(0.0214)	(0.0217)
pop_gr_log	**-0.0702***	0.000669	0.0269	**-0.0702***	0.000830	0.0270
	(0.0276)	(0.0290)	(0.0301)	(0.0277)	(0.0290)	(0.0301)
InterstateDur				-0.000422	**-0.0847*****	-0.0146
				(0.0181)	(0.0212)	(0.0189)
Constant	**7.790*****	**6.077*****	**6.140*****	**7.790*****	**6.088*****	**6.141*****
	(0.157)	(0.0943)	(0.0974)	(0.157)	(0.0942)	(0.0974)
Observations	1565	5534	5811	1565	5534	5811

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 21: Fixed-effects regressions with current OECD, non-oil, and all countries from 1960-2011 with and without conflict inclusive human capital

	(Log GDP/emp) OECD	(Log GDP/emp) Non-Oil	(Log GDP/emp) All	(Log GDP/emp) OECD	(Log GDP/emp) Non-Oil	(Log GDP/emp) All
hc_log	**2.123*****	**1.296*****	**1.191*****	**2.122*****	**1.289*****	**1.185*****
	(0.0385)	(0.0250)	(0.0244)	(0.0386)	(0.0250)	(0.0244)
Inv_log	**0.255*****	**0.150*****	**0.149*****	**0.256*****	**0.148*****	**0.149*****
	(0.0266)	(0.0108)	(0.0104)	(0.0266)	(0.0108)	(0.0104)
pop_gr_log	**-0.0382****	**-0.0308****	**-0.0363*****	**-0.0383****	**-0.0315****	**-0.0368*****
	(0.0126)	(0.00960)	(0.00972)	(0.0126)	(0.00958)	(0.00970)
InterstateDur				-0.00380	**-0.0313*****	**-0.0246*****
				(0.00841)	(0.00719)	(0.00627)
Constant	**7.631*****	**7.852*****	**7.947*****	**7.630*****	**7.863*****	**7.952*****
	(0.0942)	(0.0425)	(0.0418)	(0.0943)	(0.0425)	(0.0417)
Observations	1565	5534	5811	1565	5534	5811

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

CHAPTER 2

FINANCIAL CRISES AND THE ONSET OF CIVIL WAR

2.1 Introduction

Financial crises have widespread effects to governments and consumers in an economy: consumer wealth declines, government budgets are drained to purchase failing banks and assets, and business investment falls along with consumer confidence. Of the 128 of civil wars, in Tables 34 through 36, 25 systemic banking crises have coincided with the onset of war or preceded it by 5 years. The prevalence of civil wars was also highest in the 1990s and curiously conflict-affected countries also faced more financial crises during the same period on average.

Therefore, if there is a relationship between banking crises and civil war, perhaps it is noticeable in the costliest banking crises since 1970: Indonesia in 1997 and Guinea-Bissau in 1995. From Figures 4 and 5, the costliest banking crises in terms of fiscal cost and increases in debt concurrently experience or are superseded by civil war. This suggests that conditions arising from a financial crisis can spur people to rebel.

This paper addresses the role of financial crises and the economy in relation to civil war. We seek to determine whether a financial crisis can spur a rebellion for government control or cause fighting with the government over local issues across an international sample of countries with different levels of income from 1970 to 2007. This issue is explained using background theory in conflict and empirical estimation using panel time-series logit regression techniques.

Two models for the onset of civil war primarily explain rebel motivations: grievance and opportunity. A model of grievance-based risk, such as in Fearon (2003),

determines civil war's risk through ethnic and religious differences, the level of democracy which offers government representation of such diversity, and income inequality. The economic opportunity model of civil war's onset from Collier and Hoeffler (2004) suggests rebel motivations are better explained by opportunity (greed) instead of grievance. Economic variables such as GDP and primary commodity exports (including oil and diamonds) predict the incentives for people to take up arms against their government and other groups. A country with low GDP per person indicates greater benefits and lower opportunity costs to civil rebellion. An increase in primary commodity exports correlates to an increase in rents to be collected by the government and potential profits in export markets – both cases make armed conflict more probable (Collier and Hoeffler, 2004). This economic explanation is incomplete as other economic events can lower the opportunity cost of conflict and increase the relative benefits to rebellion – namely a systemic banking crisis that lowers employment, consumer wealth, and a government's ability to provide services and infrastructure to grieved citizens.

We estimate opportunity and grievance models from Collier and Hoeffler (2004) with base economic and political science variables but include measures of finance and banking: deposit to GDP ratios, capital formation, hyperinflation, and a financial crisis dummy to capture the effect of financial instability and rising prices on civil war's risk. A systemic banking crisis significantly predicts the onset of civil war thus providing evidence that finance matters in civil war. In the subsample of Africa, a region with heavy conflict in the 1990s, financial crises predict the onset of civil war within 5 years. The onset model for the Asian subsample predicts civil war within 2 years of a systemic

banking crisis. Samples of low income and highly-indebted poor countries (HIPC) reveal a greater risk of civil war developing from financial crisis.

To understand the economic impetus for civil war, first a summary of civil war literature is needed. This flows directly into a discussion of the variables: motivations behind their inclusion, their size of influence, and the difference between “greed” and “grievance”. Then models of opportunity (greed) and grievance are analyzed separately and together including financial crisis determinants. I follow this by estimating onset in the subsamples of Africa, Asia, and highly-indebted poor countries. Then I distinguish between two types of war: a war for government control and a war over local issues.

2.2 Why civil war and finance?

Civil war occurs more frequently than international war and has spillover effects to neighboring countries (Hegre et al., 2011). Collier (1999) contends that civil wars can be “more damaging than international wars” due to the locale of destruction. Given the greater frequency and severity of civil war than international war and the prevalence of financial crises since the 1970s, the theory and estimation of civil war’s onset related to financial markets seems worthy of examination.

Civil wars and financial crises have much in common, for instance, they are both contagious (Bordo and Murshid, 2000; Hausken and Plümper, 2002; Murdoch and Sandler, 2002). Capital formation declines in both cases and capital flight increases (Davies, 2007; Greene, 2002). The onset of conflict and financial crises is also related to a weak, indebted government. Output losses are common in both cases as in Cerra and Saxena (2008) wherein civil wars create larger declines in output, but are less persistent than financial crises. Government spending increases substantially in war

and financial crisis: to finance the war through military expenditure (Braun and McGrattan, 1993) or to purchase failing financial assets like non-performing loans from banks (Valencia and Laeven, 2008). Both civil wars and financial crises are aberrations to a stable economy and government, but economic instability and government inefficacy may also cause both. In any case, due to the similarity of determinants and their contagious nature, crises and civil wars may in fact be related such that the conditions arising from a financial crisis create an environment conducive to civil war.

2.3 Literature review

2.3.1 Civil war's onset

The research related to civil war risk began in the late 1990s (Collier, 1998; Fearon, 1998) and early 2000s (Collier and Hoeffler, 2004;Fearon and Laitin, 2003), shortly after the greatest amount of countries experienced civil war[4]. The base regression in Fearon and Laitin (2003) contains measures of gross national income, population, percent of mountainous terrain, oil production, democracy, and others which were modeled first in Fearon and Laitin (2003). In Collier and Hoeffler (2004), similar variables are included along with economic variables of GDP, GDP growth, and primary commodity exports[5].

Collier and Hoeffler (2004) explain civil war's onset economically in terms of opportunity cost alongside measures of ethnic and religious fractionalization,

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[4] See Tables 34 through 36

[5] However, Fearon (2005), in contrast to Collier and Hoeffler (2004), finds that primary commodity exports insignificantly explain the onset of civil war. Fearon explains that oil exportation, which is correlated with primary commodity exports at r=0.46, is significant and this is the determining factor in civil war's onset.

democracy, and income inequality. Some differences between the opportunity model of Collier and Hoeffler (2004) and the grievance-based model in Fearon and Laitin (2003) are that Collier uses logged GDP per capita and GDP growth, instead of gross national income per person. Collier and Hoffler (2004) also implement logged population in the current year as opposed to Fearon's 1-year lag of logged population. The reason for this may be related to the complexity involved in determining the start and end dates of civil war and the estimation in 1-year and 5-year groups discussed below.

There are two main datasets of civil war: the Correlates of War project and the Uppsala/PRIO database. One difference between these conflict datasets is the date of civil war onset[6] and Collier and Hoeffler (2004) may account for this by recording the onset if civil war began during a five-year time period. In contrast to the five-year measure, this paper is concerned with yearly changes[7] and takes advantage of the Correlates of War database which is accurate to the start day of conflict. A yearly estimation of civil war's onset allows for more observations than 5-year average estimations and therefore rigorous panel-time series regression techniques which require many observations.

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[6] See discussion in section 2.5.1 Correlates of War and Uppsala/PRIO.

[7] Other civil war onset analyses have considered yearly analyses, such as Fearon (2005).

2.3.2 Government's role in civil war

This paper argues that systemic banking crises play a role in the onset of civil war and therefore government spending and policy during a financial crisis[8] must also be important. Easterly (2001) positively connects political instability to government consumption - ineffective governments consume more. Barro (1989) finds an inverse relationship between growth and government consumption hence as economic activity declines, the risk of civil war increases[9] along with government consumption. Collier (1999) adds to this sentiment and writes, "the government's capacity to collect revenues and provide essential services" is disrupted during war. Elbadawi (1999) explains that a government involved in civil war is "less effective in dealing with poverty". A government in civil war spends more, yet collects less revenue from its tax base and is less effective in providing wealth-improving services to its citizens.

In addition to the issue of government capacity to provide services, there is also an issue with the perception of government policy changes. The policies of an indebted government in civil war are less likely to be seen as credible by rebel forces (Elbadawi, 1999). Any government policy changes may be seen as simple appeasement to end a conflict and not indicative of long-lasting change that rebels desire.

For a government involved in war, victory depends upon a taxable base that increases government revenues and therefore military capacity (Elbadawi, 1999). This

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[8] For instance, government policy related to purchasing insolvent banks and non-performing assets which are connected with the tradeoffs (opportunity costs) to government-provided services and development.

[9] This is explained through the economic theory of conflict using opportunity costs.

government victory seems less probable when government debt increases by 86 percent on average in the three years after a banking crisis (Reinhart and Rogoff, 2009). Therefore, the years following a financial crisis will be very important in terms of government defense and maintaining stable economic growth.

Hess and Orphanides (2001) suggest that some government leaders of non-democracies receive appropriative benefits from a conflict while the costs are left to their citizens. In summary, governments play a role in civil war through spending decisions, policy changes, taxation, and perhaps even an opportunistic motive.

2.3.3 The relationship between war and finance

A connection between civil war risk and financial markets has yet to be made, but the economy and financial markets in particular are clearly affected by war through bond markets, the accumulation of capital and its flight from the conflict zone, and overall consumption change as a result of conflict. Frey and Kucher (2001) find that European bond markets reacted to major events in World War II. After all, if a nation does not exist, it cannot service its public debt. In this case of international war, “the outbreak of the war depressed both bonds” (Frey and Kucher, 2001). However, during the war, investors in government bonds based their decisions on the country’s probability of victory and therefore the probability of repayment. A better investment decision may be to send capital abroad out of troubled areas.

Davies (2007) explains that conflict causes a risky environment for investment and induces capital flight. During a widespread internal conflict, funds may be looted or misappropriated thus motivating investors to look abroad “to a location where [funds] cannot be traced or retrieved by lawmakers” (Davies, 2007). However, Davies

acknowledges that there hasn't been analysis of capital flight before the onset of civil war.

Rose and Blomberg (2010) consider the aftermath of terrorist attacks in the economy and highlight the "immediate attention and support" needed to financial markets. Blattman and Miguel (2010) suggest that financial analysis can be applied to explain the recruitment for and organization of civil war. Blomberg and Hess (2012) determine consumption growth in the presence of conflict and find that individuals in conflict-affected countries would trade 9 percent of their current consumption to live in peace[10]. Blomberg and Hess (2012) highlight the value of tradeoffs that individuals make in an economy that may or may not experience conflict.

One reason to make such a tradeoff is due to conflict which "lowers the discount factor for valuing future welfare" by increasing the probability of death (Blomberg and Hess, 2012; Blanchard, 1985). If people are more likely to die today, they are less likely to place a high value on their future welfare. A financial crisis may also lower expected future welfare and make an individual more likely to join a rebellion.

Blomberg and Hess (2002) measure breakpoints of recession or expansion in the economy and the probability of resulting internal and external conflicts. They encode recessions and expansions with a 1 or 0 respectively and estimate the joint probabilities of a country in a state of conflict or peace given a recession or expansion in the previous period. This type of estimation is called a bivariate Markov process and

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[10] Blomberg and Hess (2012) model a business cycle via Day (1992) with conflict disruptions to find the lower bound on the cost of war.

predicts the occurrence of one event given the occurrence of another event (or events) in the previous period.

The limitations of Blomberg and Hess (2002) are in the consideration of only GDP in a state of growth or decline. Other factors which may determine the onset of war are not considered. Another consideration is that a systemic banking crisis may not result in a decline in GDP and a recession may not be related to a financial crisis. However, on average a systemic banking crisis does result in declining economic activity. The conflict-causing effects of a recession, often spurred by a financial crisis[11], may understate the role of finance and banking in creating conditions for civil rebellion.

The financial analyses so far explain the effect war has on finance, but what role can finance play in the onset of civil war? Collier and Hoeffler (2004) explain economic predictors for civil war: “dependence upon primary commodity exports, low average income of the country, and slow growth”. Primary commodity exports, like oil, are immobile, lootable, and heavily taxed thus ripe for rebel predation. Little economic growth equates to fewer job and schooling opportunities and easier rebel recruitment. Low GDP per person suggests lower opportunity costs to joining a rebel organization and government military. However, Collier and Hoeffler (2004) explain “tax revenue rises with income” and less government revenue “reduces the capacity of the government to spend on defense, and so makes rebel predation easier”. A government in debt due to financial crisis is a weak government and more likely to face opposition from rebel groups.

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[11] Since the 1990s, more than 70 percent of the total amount of recessions were related to financial markets.

2.4 The onset of civil war - a description of the main conflict variable

The measure for the onset of civil war is constructed from the Correlates of War Intra-state Wars database version 4.1[12]. The onset of war is defined as a dummy variable, 0 or 1, which indicates the first year of civil war in a country. For example, the Hukbalahap Rebellion began in 1950 in the Philippines and the 1 indicates the onset of that war in Table 22.

In this case, there is no indication of the length of rebellion or the severity of conflict. There is only a data point of "1" in 1950 to indicate something happened in 1950 to spur an uprising. This paper argues that the state of the economy, not only political governance, has an important role to play.

The Intra-state war database records wars that take place "within the recognized territory of a state" and "the war must involve sustained combat, involving organized armed forces, resulting in a minimum of 1,000 battle-related combatant fatalities within a twelve month period" (Sarkees and Wayman, 2010).

The scholars who originally developed the COW dataset, Melvin Small and J. David Singer, also differentiate between genocide and rebellion. They establish conditions such that both sides provide an effective degree of resistance. Three different types of civil war are coded: state vs. non-state entity, regional subunit of state vs. non-state, and intercommunal wars or non-state vs. non-state entities. Two types of state vs. non-state war are further identified: war for central control or over local issues.

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[12] This data can be found at: http://cow.dss.ucdavis.edu/data-sets/COW-war.

One example of civil war for central control is the Democratic Republic of Congo in the late 70s and 90s. Civil war in the Darfur region of Sudan is an example of war over local issues as the SLA and JEM do not wish for state control. The Cultural Revolution in China in 1967 is an example of regional internal war. The Christian Tarok and Muslim Fulani in Nigeria fighting amongst each other in 2004 is identified as an intercommunal war. Civil wars in Africa are typically fought for government control, while wars in Asia are fought with the government over local issues.

2.5 Alternative data specifications

2.5.1 Correlates of War[13] and Uppsala/PRIO[14]

A rebel force does not typically announce the start of its insurrection nor does the government vocalize the beginning of its counter-insurgency tactics. Therefore, there is some discrepancy in the start dates of civil war between the updated Small and Singer dataset from Sarkees, Reid and Wayman (2010) called the “Correlates of War” (COW) and the Uppsala/PRIO dataset from Gleditsch et al. (2002). The reasons for choosing the COW data are discussed in the Data section above: very accurate starting dates of war and a strict definition of civil war. The Uppsala/PRIO dataset by comparison specifies civil war slightly different. For instance, Northern Ireland is considered in a state of conflict between 1971 and 1993 for the PRIO dataset, but the episode is absent

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[13] Sarkees, Meredith Reid and Frank Wayman (2010). Resort to War: 1816 - 2007. Washington DC: CQ Press.

[14] Gleditsch, Nils Petter, Peter Wallensteen, Mikael Eriksson, Margareta Sollenberg, and H˚avard Strand (2002) Armed Conflict 1946-2001: A New Dataset. Journal of Peace Research 39(5).

in the Correlates of War. Thailand's specification of civil war lasts from 1970 to 1982 in the PRIO dataset, but only from 1972 to 1973 in COW data.

To address this issue, I also include regression results with a specification of civil war's onset from Uppsala/PRIO in Table 31. The model does not perform as well - there is less significance in the gross domestic product variables likely due to the longer specification of conflict periods by Uppsala/PRIO[15]. Also, the Correlates of War project data has been used in Collier and Hoeffler (2004) and Fearon and Laitin (2003), two sources from which this paper is inspired.

2.5.2 Penn World Tables and the World Development Indicators

Gross domestic product from the Penn World Tables have been used previously in analyzing civil war and therefore a short comparison and explanation is warranted for choosing the World Development Indicators from the World Bank. The Penn World Tables generally have earlier GDP data going back to 1960 in developing countries like Afghanistan, Ethiopia, Guinea, Guinea-Bissau, Mozambique, Somalia, and Uganda. The World Development Indicators have more data for other countries like Sudan and Sierra Leone in addition to more recent data up to 2007[16]. The analysis of conflict with financial crises occurs mainly during and after the 1990s[17], so I chose the World Development Indicators (WDI) database.

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[15] Another issue is that the Uppsala/PRIO dataset considers combatant and non-combatant battle deaths as opposed to Small and Singer's combatant battle deaths.

[16] As a side note, economic, political and financial data used in this paper are sourced from Catini and Saade (2010) (http://sites.google.com/site/md4stata/).

[17] From 1970 to 2007 there have been 375 years of systemic banking crises with 70 percent occurring after the Cold War.

A choice was made not to combine the two datasets since the specification of GDP per capita, GDP growth, and population is different in each dataset. This would result in fairly large changes from one year to the next if missing data from WDI is replaced with Penn data in the same country. Fearon and Laitin discovered this problem in Fearon and Laitin (2003) and used techniques of data generation and interpolation to derive gross national income:

> "We used income growth rates from the World Development Indicators 2001 to extend the estimates in the Penn World Tables 5.6 and then used the per capita energy consumption estimates provided by the COW project to estimate additional missing values."

In using this method to generate and compile data, a question arises as to whether the researchers are actually estimating the onset of conflict with a unified measure of gross national income[18]. In order to avoid such a complication I estimate the main regressions again using GDP per capita, GDP growth and population levels from the Penn World Tables. From Table 32, the results are very similar for Africa and Asia with WDI data, but the financial crisis dummy and its lags are insignificant for the entire sample. However, the severity of financial crisis is still a significant determinant of the onset of civil war in all samples.

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[18] For a detailed explanation of data generation in Fearon and Laitin (2003), go to: http://web.stanford.edu/group/ethnic/workingpapers/addtabs.pdf

2.6 Economic predictors of conflict

2.6.1 Gross domestic product per capita

Gross domestic product per capita, along with GDP growth and population, come from the World Development Indicators database from 2013. The log of current GDP per capita measures consumer buying power and economic well-being of a country's citizens. The common explanation for including GDP per capita in a conflict model is that it measures the opportunity cost of joining a rebellion. There is a tradeoff to starting a civil war and joining a rebellion - namely the lost wages and economic opportunities a person gives up when they decide to fight. When GDP per capita is low, the relative benefits to fighting and acquiring resources through looting are higher than otherwise.

However, when GDP per capita is low, the government can also easily recruit for the military and provide counterinsurgency measures. This suggests an important role of the government in tax collection that builds revenue to protect the country – higher GDP per capita equates to more government revenue through tax collection, greater military capacity, and less opportunity for citizens to revolt.

2.6.2 Gross domestic product per capita growth

The growth in GDP per year in percentage terms from the World Development Indicators database measures the overall growth in economic well-being per year per person. Short-term changes in income can affect the opportunity costs of rebellion as previously mentioned. The loss of employment and education opportunities make subversive activities more attractive by comparison. The less GDP growth in a given year, the more likely is a civil war to begin.

2.6.3 Population

Countries with large populations are at a higher risk of civil war than otherwise. Collier and Hoeffler (2004) suggest that both opportunity and grievance-based motives increase with population size. This variable comes from the World Development Indicators 2013 dataset as well. Population and GDP per capita are logged variables to decrease the variability that exists between countries.

John Maynard Keynes wrote about the economic consequences of World War I before his popular work on the Great Depression. In Keynes (1919), Keynes highlights the significance of a large population leading to the Russian Civil War of late 1917:

> "Thus the extraordinary occurrences of the past two years in Russia, that vast upheaval of Society, which has overturned what seemed most stable...may owe more to the deep influences of expanding numbers than to Lenin or to Nicholas; and the disruptive powers of excessive national fecundity may have played a greater part in bursting the bonds of convention than either the power of ideas or the errors of autocracy."

Keynes (1919) suggests that an expanding population may contribute more to civil war than government folly or ideological motivation. Even in the year of 1919 the underlying reasons for conflict were theorized to have motivations other than political or ethnic grievance. This is central to the economic perspective of the onset of civil war.

2.6.8 Hyperinflation

Steve Hanke and Nicholas Krus are economists at the Johns Hopkins University and they've collected 56 instances of hyperinflation dating back to the French Revolution in 1795. The exchange rate between two countries is key to identifying hyperinflation. Hanke explains, "the ratio of the price level between two countries is

equivalent to their exchange rate". If one country experiences hyperinflation, then the exchange rate with another country changes drastically. Two trading partners can therefore both eventually experience hyperinflation as rising prices "travel" through trade.

Most of the hyperinflation data is in terms of consumer prices since they "best reflect price changes experienced by the final consumer". Hanke defines hyperinflation according to Cagan (1956) which is a monthly inflation rate greater than 50 percent.

Both civil and international war are also associated with hyperinflation. Hanke explains, "Hyperinflation is an economic malady that arises under extreme conditions: war, political mismanagement, and the transition from a command to market-based economy – to name a few."[19] A regime change, for instance due to a successful rebel overthrow of government, can change the structure of government and therefore also the economy.

2.6.9 Systemic banking crises

In the midst of the 2008 financial crisis, two researchers from the International Monetary Fund prepared a database on systemic banking crises with a focus on the timing and type of crisis. This financial crisis variable comes from the updated dataset in Valencia and Laeven (2010) and identifies the start and end of 42 banking crises.

I've identified these banking crises with a dummy variable taking the value of "1" at the onset of crisis and every year during the crisis. The years for which no banking

[19] The collection of hyperinflation events can be found at: http://object.cato.org/sites/cato.org/files/pubs/pdf/workingpaper-8.pdf.

crisis occurred receive a value of “0”. This variable identifies the onset and duration of financial crises associated with banking.

The timing of a banking crisis is determined by the amount of non-performing loans as a percentage of total loans, gross fiscal costs and output loss as a percentage of GDP, and minimum real GDP growth. The researchers cross-check the crisis dates with the timing of deposit runs, deposit freezes, liquidity support, and bank interventions (Valencia and Laeven, 2008). This variable is positively correlated with civil war.

Demand deposits and capital formation as a percentage of GDP, along with real GDP growth are also described below as they are significant predictors of the onset of civil war in addition to financial crisis. Many conditions requisite for financial crisis are also shared by civil war due to the relative decrease in opportunity costs of rebellion and relative increase in benefits through stolen commodities, rents on those commodities, or government control and appropriation of wealth.

2.6.10 Financial crisis severity

Valencia and Laeven (2008) measure the output loss to GDP in the years following the onset of financial crisis to determine it’s severity. Therefore, the output loss can be calculated as the difference between potential GDP and actual GDP over the entire period of crisis. However, the estimate in Valencia and Laeven (2008) doesn’t account for yearly losses in output.

Therefore, the financial crisis dummy, which takes a value of “1” for every year in which the crisis occurs, can be multiplied by the GDP growth rate from the WDI database to determine the yearly declines in GDP associated with the systemic banking

crisis. This variable operates as a measure of crisis severity[20] – larger declines in GDP will increase the risk of civil war given the economic (opportunistic) motivations for civil war.

2.6.11 Deposit money - bank assets (percentage of GDP)

Valencia and Laeven (2008) explain, “In some cases, the crisis is triggered by depositor runs on banks, though in most cases it is a general realization that systemically important financial institutions are in distress.” Banks that are in financial trouble will try to prevent customers from withdrawing their money through bank holidays and deposit freezes to maintain what assets they do have in the midst of rising costs from non-performing loans. This variable is measured as a percent of GDP and is negatively related to conflict. More bank assets relative to GDP equate to less chance of financial crisis and civil war.

2.6.12 Gross capital formation (percentage of GDP)

During a systemic banking crisis, financial capital is exhausted and capital flows may slow or even reverse (Valencia and Laeven, 2008). There will simply be less demand for capital investment during crisis. This variable comes from the World Development Indicators 2013 dataset and is measured as a percent of GDP. It is also negatively related to financial crises and civil war.

During a financial crisis and civil war, people will seek stable sources of investment for their wealth. The possibility of looting during civil war is higher than

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[20] An alternate method may involve finding the average output loss per year associated with the crisis, similar to finding the average number of battle deaths per year associated with civil war in the following chapter.

otherwise and a bank in arrears may not offer such stability. Therefore, one would expect less domestic capital investment.

2.6.13 Male enrollment in secondary education

The combatants in civil wars are likely to be young men. If young men choose to attend school, then they increase the opportunity cost of participating in rebellion. The foregone future wages from a secondary school education must be equal to or less than the future benefit of rebellion for a young man to fight in a civil conflict. Therefore, fewer young males will be in school in a country at higher risk for civil war.

Collier and Hoeffler (2004) also find a highly significant relationship between the onset of conflict and male enrollment in secondary school. This variable is included to establish similarity between past research and the current paper, comes from the WDI 2013 dataset, and has a negative relationship to the onset of civil war.

2.6.14 Fuel exports (percentage of merchandise exports)

Countries that have more exports comprised of oil, diamonds, and other natural resources are at higher risk for civil war since the acquisition of such goods can be financially lucrative. A government can also extract high rents from the production and exportation of oil thus increasing the benefit of civil war for government control. Collier and Hoeffler (2004) explain that grievances play a role in recruitment of rebels, but sometimes the underlying reasons for civil unrest are economic.

The financing of rebellion, according to Collier and Hoeffler (2004) and Dodds (2002), involves the extortion of natural resources. Collier models this extortion through the presence of high levels of primary commodity exports which include conflict resources like oil and diamonds. Fearon (2005) argues that the inclusion of primary

commodity exports in Collier (2004) may capture a real driver of conflict which is oil exportation. The oil exportation variable presented in this paper is fuel exports as a percentage of merchandise exports from the World Development Indicators 2013 database[21]. It is positively correlated with the onset of civil war. When fuel exports comprise a large percentage of exports, the probability of conflict is higher.

2.7 Grievance-based indicators of conflict

2.7.1 Ethnic fractionalization

Many of the conflict models mentioned previously include a measure of ethnic diversity called ethnic fractionalization. James Fearon collected this data by country and year with each data point measured as a value between 0 and 1. If you randomly select two people from a population, this variable measures the probability that they came from different ethnic groups. Therefore, countries with values close to one are ethnically heterogeneous (diverse) and countries close to 0 are ethnically homogenous.

Previous work from Fearon and Laitin (2003) and Collier and Hoeffler (2004) have found that “more ethnically diverse countries show no strong tendency to have a greater risk of civil wars if one compares states at similar levels of economic development” (Collier and Hoeffler, 2004). One explanation for this is that grievances are not shared equally among different ethnic groups and it is therefore harder to organize and recruit for a rebellion in ethnically diverse communities. This variable is generally negative in determining conflict - the more ethnically-heterogeneous the society, the smaller the chance of civil war.

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[21] This variable is also similar to primary commodity exports used in Reynal-Querol (2002).

However, when a country has greater than 45percent ethnic majority, then it is sufficiently homogenized and ripe for rebel organization and government oppression. The majority group is then large enough to oppress the minority group through government policy and other social means. This ethnic majority dummy variable is positively related to civil war.

2.7.2 Democracy

Polity is another significant determinant of civil war used in Fearon and Laitin (2003) and Collier and Hoeffler (2004) that measures democracy on a scale from -10 to +10. Strongly democratic governments will receive positive values close to 10 and more autocratic governments receive negative values close to -10. This variable is negatively related to all forms of conflict – more democratic societies lead to less conflict.

One reason for this is that people of minority ethnic backgrounds have more influence in government policy in democratic societies. With government representation, there is less reason to hold grievances against the ethnic majority (Ellingsen, 2000). However, in terms of changing government policy, democratic societies are much less effective (Reynal-Querol, 2002).

2.7.3 Political constraints

The feasibility of government policy change is a very high determinant of the risk of civil war onset. We might expect more feasible policy changes in democratic governments and if people see that a government can change, then they are less likely to rebel against it; however, this is not the case.

Reynal-Querol (2002) discusses this relationship between political systems and conflict. She concludes that in a proportional system (a politically fractionalized

government) the “opportunity cost of rebellion is higher than in a majoritarian system” Reynal-Querol, 2002). She explains that this representation in government is more important for peace than the level of democracy, i.e. polity.

With more political constraint, and less change in government policy, we see a lower risk of civil war. The index score ranges from 0 to 1 with “higher scores indicating more political constraint” (Teorell et al., 2015). The index accounts for the number of branches in government with veto power, the degree of party alignment within the branches (less party alignment means more political constraint), and the degree to which preferences are unaligned within each legislative branch, i.e. legislative fractionalization. A divided house will not fall and also will not change government policy.

A more diverse government actually allows for more political constraints, less chance of changing government policy, and less chance of civil uprising. If people see that a government can change its policies easily, they are more likely to rebel. Legislative fractionalization may be the driver in increasing the risk of civil war.

The countries in which civil wars occur have very low political constraints –a great deal of party alignment in legislative branches, fewer independent branches with veto power, and majority preferences in common. In aggregate, this allows for easy change to government policy and more probably policy change in favor of the majority group.

The political constraints index highlights the importance of political representation in government – less minority representation equates to fewer political constraints and a higher risk of civil war. This variable actually performs much better than the traditional

inclusion of ethnic fractionalization and polity over a long time period with many observations. It is a variable from the Quality of Governance dataset from Teorell et al. (2015).

2.7.4 Regime durability

The duration of peace between civil wars has been an explanatory variable in previous conflict models[22] and regime durability measures the number of years since a change in regime (government). The change in government is indicated by a 0 and every year that follows receives a value of 1 until the next regime change. The regime change is determined by the polity scale in a year for which the country becomes substantially more democratic or autocratic (+/- 3 points). This is another Quality of Governance indicator variable.

2.7.5 Cold War and fuel export dummy variables[23]

A dummy variable has been proposed in the conflict literature to distinguish between times before and after the Cold War (Lacina, 2004; Collier and Hoeffler, 2004; Collier and Rohner, 2008). This Cold War variable takes the value of 1 for years after 1990 and 0 otherwise. The inclusion of this dummy does not significantly improve the regressions, except in Africa where the prevalence of conflict increased in the 1990s.

Fuel exports greater than 30percent of total exports have been hypothesized as significant contributors to the onset of conflict in Fearon (2003); however, this variable does not enter significantly into any variants of the onset regression.

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[22] One example is from Collier and Hoeffler (2004).

[23] These variables were insignificant in my regressions and therefore not included in the tables or results.

2.7.6 Inequality – Gini index

To better model the effect of grievance on civil war, we must also consider income inequality. A country that distributes wealth more evenly is less likely to experience civil unrest on average. Grievances occur when wealth is concentrated among a small percentage of the population and the rest are left in poverty.

Typically emerging countries have greater income inequality than developed countries – as a country develops, wealth is accrued, and people can afford better government services. More money is acquired by the government and distributed equally among citizens as the country develops. The developed country is also less likely to have its citizens rebel and overthrow a government which improves their living conditions.

The Gini index is measured on a scale from 0 to 100 with countries closer to zero having very equal distribution of income and countries closer to 100 having more income inequality. As a reference point, the U.S. had a GINI index value of 46.4 in 2004 and a conflict-prone country, Nicaragua, had a score of 52.3 in 2005.

2.8 Methods

The logit model estimates a binary dependent variable which takes only the values of one or zero. This dependent variable is qualitative in nature which means it explains something like an event, instead of a dollar value or quantitative amount. In contrast to a linear probability model, like with ordinary least squares, the logit model generates coefficients which are the change in the log odds of civil war's onset with an increase of one unit in the independent variable. To make practical sense of the effect of financial crises on civil war, we determine predicted probabilities for an average

country in the entire data set and in each subsample. This probability is sometimes called the response probability (Wooldridge, 2008) and takes a value between 0 and 1:

$$P(y = 1|x) = P(y = 1|x_1, x_2, \dots, x_k)$$

A fixed-effects estimation with static variables such as ethnic and religious fractionalization along with polity (our measure of democracy) is inappropriate and random-effects is chosen instead. The Hausman test can verify our choice as well, but in simply comparing regression results, the logit and panel time-series logit models are very similar.

Fixed-effects estimation controls for ceteris paribus effects through the arbitrary correlation between a_i and x_{itj}. With static variables, i.e. variables which do not change over time, fixed-effects estimation is not appropriate. With random-effects estimation we expect some unobserved effect which is not correlated with other independent variables (Wooldridge, 2008). The random-effects logit estimator for panel time-series has the following form:

$$P(y_{ij} = 1|x_{ij}, u_i) = F(x_{ij}b + u_i)$$

One issue with using logit models is the lack of R^2 or simply a good measure of fit. Log likelihood values are only effective when comparing one regression model to another. Therefore, as a very basic means of comparability between models I include the log likelihood values in each table of results for the onset of war.

2.9 Estimating the onset of civil war

During a civil war, it is difficult to distinguish between rebel fighters and looters or bandits. Early models of conflict by Grossman (1999) suggest that civil insurrections can

generate profitable opportunities that a time of peace may not. The impetus from this viewpoint is greed, not grievance.

If economic conditions like low GDP per capita, low GDP growth, and a high percentage of commodity exports can determine the risk of conflict's onset, then an economic event like a financial crisis which lowers consumer wealth and drains government budgets can also predict the onset of war. At the onset of a financial crisis, bank deposits are low due to consumers removing their wealth from the unstable institutions. With bank assets declining and financial costs rising due to non-performing loans, banks typically lend less money to their customers. As a result, business investment declines and the percentage of capital formation to GDP also declines. Although financial crises begin for many different reasons, this is a common theme since financial crises have been recorded in 1970.

2.10 Results

2.10.1 The opportunity model

I regress the onset of conflict in the entire sample on the base regression variables from Collier's opportunity model with the inclusion of specific financial crisis predictors. The results in Table 23 indicate the strong predictors of GDP growth, GDP per capita, peace, and population on civil war's risk.

Model 1 and 2 in Table 23 are close reproductions of the opportunity model in Collier and Hoeffler (2004); however, they show that fuel exports as a percentage of merchandise exports (and it's square) do not significantly predict civil war. This variable measures only fuel exports, similar to Fearon (2005), instead of primary commodity

exports from Collier and Hoeffler (2004). James Fearon presents a host of reasons[24] why primary commodity exports are inappropriate in a country-year analysis in Fearon (2005); therefore I use a variable more related to fuel exports as he suggests.

The economic variables of GDP growth, population, GDP per capita and the measure of regime durability (peace) from Table 23 Model 3 significantly predict the risk of civil war. Now with a base regression of significant variables, I add financial variables that may predict the risk of conflict.

In Model 4 of Table 23, the deposits to GDP variable is included as an expression of banking health and consumer confidence in banks as a storehouse of wealth. If people do not trust banks to remain solvent, then they remove their assets and financial markets suffer.

If declining bank deposits are related to financial crisis, then it makes sense to simply test the start and duration of a financial crisis on civil war's onset. In Model 5 from Table 23 the financial crisis dummy variable has no significant effect when the crisis occurs in the same year as the civil war's onset. The financial crisis does have a significant effect in Model 6 of Table 23 when it occurs 5 years before the beginning of civil war. This suggests that a financial crisis has some relation to a civil war when it precedes the war by 5 years.

The coefficients from random-effects logit estimation, for example in Model 6 of Table 23, do not represent predicted probabilities, but log odds of civil war's onset. The

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[24] Fearon (2005) argues mainly that primary commodity exports are driven by oil exports which is evident in a yearly analysis, instead of the 5-year panel from Collier and Hoeffler (2004).

risk of civil war's onset when an average country has faced a financial crisis 5 years prior are approximately 1.6percent in the opportunity model. This small risk must be considered in the context of a completely average country – when other factors are taken into account, this risk increases substantially as is evidenced in later analysis.

2.10.2 The grievance model

The political science literature often explains the onset of war in terms of political/governance and grievance variables[25]. Collier and Hoeffler (2004) propose a model similar to Table 24, wherein ethnic fractionalization, religious fractionalization, ethnic dominance, democracy, regime durability, and population determine the onset of civil war. In Table 24 Model 1, religious fractionalization does not seem to play any significant role in the onset of war[26]. The Gini measure of inequality is measured separately due to low observation numbers in Table 24 Model 2 and is only significant at 10percent. This may explain conflict's onset better than ethnic fractionalization as ethnic fractionalization and the ethnic majority variables lose significance. It is likely that ethnic groups are also divided by income such that these variables are related.

In any case, by dropping the insignificant variables, a highly significant base regression can be tested with new variables: political constraints, deposits to GDP, and the financial crisis dummy. Political constraint is a measure of legislative fractionalization that leads to new government policy changes. This variable, as opposed to polity, has been proposed to be the real driver behind non-democratic

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[25] However, new literature has taken more economic factors into account.

[26] This non-effect has been suggested before in Collier and Hoeffler (2004).

governments' experience of conflict (Reynal-Querol, 2002). In Table 24 Model 3 the variable enters significantly and is therefore used in the combined model's analysis that follows.

The addition of financial variables do not work very well in tandem with measures of political grievance. Only the deposit assets to GDP variable explains the onset of conflict significantly in Table 24 Model 4. The 5-year lagged crisis variable predicts war's onset with probability of 2percent. It may be more instructive to consider the political grievance variables together with economic opportunity variables in Table 25.

2.10.3 The combined grievance and opportunity model

The combined opportunity and grievance model in Table 25 closely follows specifications in Collier and Hoeffler (2004): fuel exports as a percentage of total merchandise exports, fuel exports squared, GDP per capita, GDP growth, peace, population, ethnic fractionalization, religious fractionalization, ethnic dominance, democracy, and political constraints on passing new government policy. From Model 1 to Model 2 in Table 25, I drop the insignificant variables of fuel exports and religious fractionalization which were previously determined insignificant. Model 2 shows the greater explanatory power of economic variables as opposed to political variables in the onset of civil war[27]. Also, a combination of variables from Models 1 and 2 from Table 25 become the base regressions in all subsample estimations by region and income that follow.

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[27] This comparison is a key discovery from Collier and Hoeffler (2004) and provides evidence for economic explanatory power in civil war, instead of the common grievance-related explanations for conflict.

The banking crisis dummy variable should not significantly predict the onset of civil war in the current period, but it predicts civil war 5 years after the crisis incidence. The interpretation of the crisis coefficient in Table 25 Model 4 is the log odds of civil war risk – the predicted probability of civil war due to a financial crisis in an average country is 1.8 percent.

For the case of Indonesia and Guinea-Bissau, in Figures 1 and 2, the severity of the banking crisis may also play a role in the probability of civil war. The severity of a financial crisis determines the decline in consumer wealth, economic opportunities, and government budgets. In Table 25 Model 5, this 5-year lagged variable, along with deposits to GDP, is significant at the 10 percent level. The greater the financial crisis, the larger the decline in GDP, and the higher the probability of war's onset[28]. The fewer deposits a bank has on reserve as assets, the greater the probability of war as consumers distrust the bank's ability to hold their wealth and governments buy out insolvent banks and depreciated assets.

During this 5 year period, the government is typically heavily indebted. Reinhart and Rogoff (2009) explain that "on average, government debt rises by 86 [percent] during the three years following a banking crisis". If we consider highly-indebted poor countries, 25 percent are conflict affected and most of these are in Sub-Saharan Africa. Therefore, I divide the sample by continent and analyze the continents where most civil wars occur: Africa and Asia.

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[28] See discussion of highly-indebted poor countries and low income countries for a more in-depth analysis.

2.10.4 Civil war's onset in Africa

We suspect that African or Asian economies are driving the 4 to 5 year significance of the crisis variable in the entire sample. After all, from the civil wars listed in Tables 34 through 36, developed countries that experience a financial crisis do not usually experience a civil war afterward. Table 26 Model 1 shows that very few of the independent variables significantly contribute to the risk of civil war in Africa. I drop insignificant variables in Model 2 and settle on Model 3: population, GDP growth and democracy are important African indicators of war.

From Model 4 in Table 26, adding a systemic banking crisis dummy variable significantly predicts the onset of civil war in Africa 5 years after the crisis event. The risk of conflict in an average African country increases to 3.6 percent; however, this crisis variable should be considered in conjunction with other independent variables. For example, we will see that if a financial crisis predicts civil war and the country has an ethnic majority, the probability of conflict increases substantially.

The severity of such systemic banking crises is also important in Africa[29]. If a banking crisis is associated with steep declines in GDP, this raises the probability of civil war in proportion to the size of crisis according to economic theories of conflict.

2.10.5 Civil war's onset in Asia

Asian countries, in contrast to Africa, are affected more quickly by systemic banking crises. In Table 27 Models 1 and 2, several independent variables insignificantly explain conflict's onset and are dropped. Model 3 includes GDP per

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[29] However, crisis severity is not important in Asia in terms of civil war risk.

capita, GDP growth and population as significant predictors of war risk. In Model 4, the current period financial crisis has no effect, but a financial crisis can increase the risk of civil war by 5.6 percent over a time span of 2 years.

From Models 6 and 7 in Table 27, declines in capital formation play a greater role in Asia than Africa[30]. The predicted probabilities of conflict change depending on the range of capital formation as a percent of GDP the country currently experiences. For instance, an average country with 0 to 10 percent capital formation significantly increases war risk by 5.6 percent. With 10 to 20 percent capital formation, there is a 3.3 percent probability of war and from 20 to 30 percent capital formation there is a 2 percent chance of conflict. These probabilities of conflict can be taken in tandem with financial crises: civil war's risk increases from 5.6 to 15 percent, 3.3 to 9.5 percent, and from 2 to 5.9 percent over the previously mentioned intervals of capital formation. Each variable's contribution to the onset of war must be considered with other significant predictors in order to find the total probability of war beginning.

2.10.6 Civil war for government control and over local issues

The economic explanations for conflict deal with falling opportunity costs and loss of wealth. The well-known losses to wealth and employment during and after a financial crisis seem to contribute to the risk of conflict in a country. However, it is not clear what type of conflict arises from financial losses - a war for government control or simply a war over local issues? Tables 28 and 29 display the results for the onset of both types of wars and includes financial crisis variables.

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[30] However, bank deposits to GDP are important predictors of war's onset in Africa.

In Table 28, a war for government control is motivated by low GDP per capita and GDP growth, the extent to which government policy represents the will of the people, and the number of years the state has peacefully governed. Ethnic diversity and population size play no role in motivating war for government control. A systemic banking crisis which occurs concurrently with civil war does not explain the war's onset. However, 5 years after the incidence of financial crisis the risk of civil war for government control becomes 0.96 percent.

Governance variables like political constraints, levels of democracy, and regime stability are very important determinants for a civil war for government control. However, they are important to the extent that they influence income per capita and growth. Grievances are fueled when an opposition party has no influence on government policy. A government at risk of being usurped offers shorter periods of peace and homogeneous government representation.

Civil wars fought over local issues, in Table 29, have different determinants than wars fought for government control. Population size and GDP growth are strong determinants for wars involving local issues. Governance does not play any role in these wars except to the extent that a government prevented such wars from occurring in the past. Such wars may also be more spontaneous and involve less planning than a government takeover. In any case, a systemic banking crisis precedes wars over local issues by 2 years and the probability of civil war for local issues is 0.4 percent.

2.10.7 Civil war in highly-indebted poor countries (HIPC)

If government spending and debt play a role in the onset of civil war, perhaps the highly-indebted poor countries are at more risk of civil war than countries with low

income. If civil war happens more frequently as a result of financial crises in the indebted countries, then the probability of war in the HIPC subsample will be larger.

First, in Table 30 Models 1 and 2, the other explanatory variables explain the onset of civil war poorly due to few observations in the fuel exportation variable and less explanatory power of population and governance variables. In Model 2, dropping the fuel exportation variable yields just over 1,000 observations; in Model 3, the GDP per capita level, GDP growth, maintaining an ethnic majority, and democracy explain the onset of war significantly in highly-indebted poor countries. From this base regression an analysis of financial crisis' role takes place.

From Table 30 Models 4 and 5, the coefficient on the banking crisis dummy is 1.30 in HIPC as opposed to 0.61 in the entire sample and 0.96 in Africa for the 5-year lag and 1.32 in Asia for the 2-year lag. Highly-indebted poor countries share with Asia the greatest risk of civil war resulting from the incidence of financial crisis. This link between indebted countries and civil war has received little attention in the conflict literature.

To strengthen the debt connection with civil war, I compare a sample of low-income countries to the highly-indebted poor countries. Ethnic dominance, GDP growth and democracy are significant determinants of civil war in both low income and highly-indebted poor countries. I compare the financial crisis dummy and crisis severity variables to find that the risk of conflict following an incidence of financial crisis is higher in the indebted poor countries. However, the severity of a financial crisis more significantly determines civil war's onset in low-income countries. If a low-income

country also has an ethnic majority, the predicted probabilities of war more than double in some cases.

2.10.8 Civil war and hyperinflation

Another financial event that erodes consumer wealth and decreases the opportunity costs of joining a rebellion is hyperinflation. The connection between war, international and civil war, and hyperinflation is easily seen after World War I and II in Hungary, other post-WWII European countries, and African countries in the 1990s during the African World War. Hyperinflation occurs after large, international wars, but an argument can be made that it starts civil wars as well.

I collect the base regressions from each subsample in Table 33 and include the hyperinflation dummy variable which is constructed identically to the financial crisis variable (It takes the value of 1 for every year in which prices increase, even for a short time period, more than 50 percent). Hyperinflation has no significant effect in the entire sample simply due to its rare occurrence.

However, the Democratic Republic of Congo and Angola have instances of reoccurring and prolonged hyperinflation in the 1990s. These significant events drive the estimation results in Africa (Table 33 Model 2) and yield the largest coefficient in civil war's risk yet, 2.25, which are log odds of the outcome of war. These were wars for government control and only the Democratic Republic of Congo is a highly-indebted poor country.

2.11 Conclusion

This paper builds upon the previous economic models of conflict proposed by Collier and Hoeffler (2004) by including systemic banking crisis and financial variables

associated with crisis. The event of financial crisis decreases personal wealth and therefore the opportunity cost of joining a rebellion. It also depletes a government's budget through purchases of non-performing loans and protecting banks from insolvency. This implies a tradeoff with spending on services, infrastructure, and monetary concessions to rebel groups. The indebted government becomes weak and ripe for rebel takeover.

I showed this through panel-time series logit estimation of the onset of conflict with economic and political variables common in the conflict literature and financial variables. A systemic banking crisis increases the chance of civil war in 2 and 5 years by between 3.6 and 5.6 percent in Asian and African economies. Civil wars develop more quickly as a result of financial conditions in Asia than in Africa. A civil war for government control is preceded by a financial crisis within 5 years and civil war over local issues is preceded by crisis within 2 years of its onset.

By comparing low-income and highly-indebted poor countries, evidence arises for the role of strong governance in preventing civil wars. A government in debt due to financial crisis faces a spending tradeoff between supporting insolvent banks and providing services for its citizens that improve well-being. Strong financial institutions in which people store their wealth are also important. When people do not deposit their money into banks, they are insecure about their expected future wealth and this increases the risk of civil uprising. If the government cannot insure a stable environment for capital to accrue, the risk of conflict also rises.

The probability of civil war increases substantially in low-income countries when controlling for other conditions like an ethnic majority with financial crises. This suggests

that to practically consider a country's risk for civil war, all significant variables must be taken into account and not just the probability associated with a single financial crisis event (ceteris paribus).

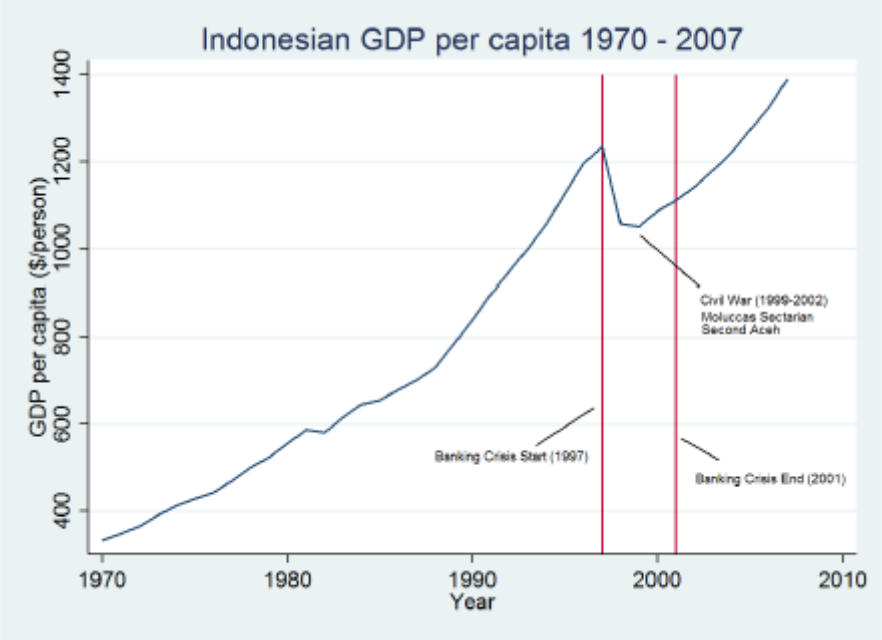

Figure 4: Severe banking crises in Indonesia and civil war's onset

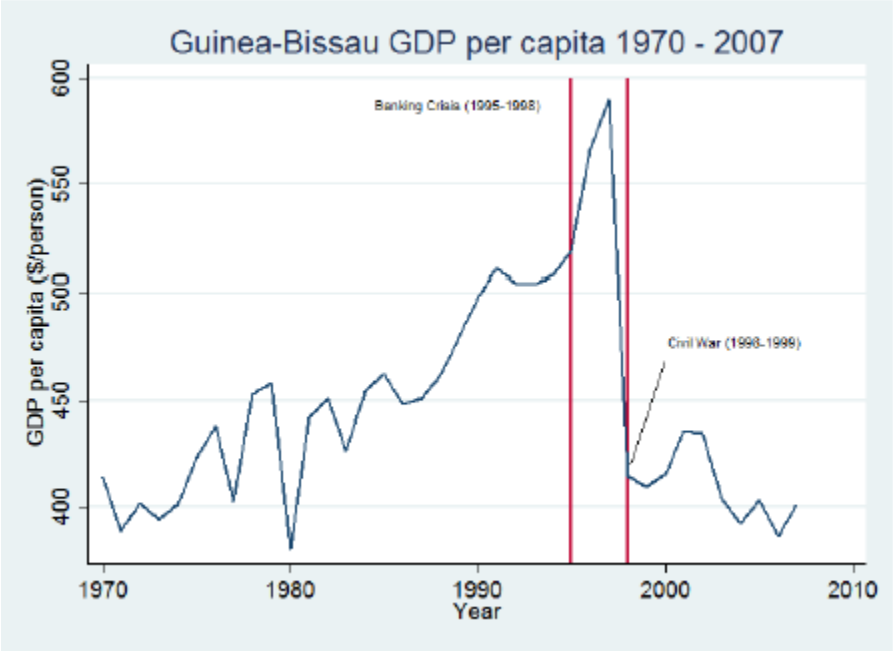

Figure 5: Severe banking crises in Guinea-Bissau and civil war's onset

Table 22: Civil war's onset

Country	Civil War	1950	1951	1952	1953	1954	1955
Philippines	Hukbalahap Rebellion	1	0	0	0	0	0

Note: This measures the onset of conflict with a "1" and "0" otherwise.

Table 23: Opportunity model: Random-effects logistic regression for civil war's onset 1970-2007

	(1) civilwar_onset	(2) civilwar_onset	(3) civilwar_onset	(4) civilwar_onset	(5) civilwar_onset	(6) civilwar_onset
civilwar_onset						
TX_VAL_FUEL_ZS_UN	-0.00830	-0.00381				
	(-0.15)	(-0.15)				
FuelSqr	0.000161	0.000114				
	(0.29)	(0.40)				
une_sem	-0.0367**					
	(-2.28)					
GDPgrowth2	-0.130	-0.0677***	-0.0713***	-0.0198	-0.0703***	-0.0730***
	(-1.40)	(-2.97)	(-5.45)	(-0.79)	(-5.29)	(-5.55)
p_durable	-0.0846*	-0.0235*	-0.0242**	-0.0245*	-0.0240**	-0.0232**
	(-1.82)	(-1.72)	(-2.48)	(-1.80)	(-2.46)	(-2.38)
le_etfra	-2.492	-1.125				
	(-1.64)	(-1.45)				
Poplog2	0.971***	0.473***	0.379***	0.636***	0.377***	0.373***
	(3.30)	(3.42)	(4.12)	(4.70)	(4.11)	(4.05)
GDPcaplog2		-0.656***	-0.408***	-0.354**	-0.409***	-0.408***
		(-3.66)	(-3.70)	(-2.03)	(-3.72)	(-3.71)
dbagdp				-0.0260**		
				(-2.18)		
FinDummy					0.141	
					(0.40)	
L5.FinDummy						0.564*
						(1.68)
Constant	-16.38***	-6.688**	-7.137***	-11.45***	-7.113***	-7.105***
	(-3.41)	(-2.35)	(-4.15)	(-4.46)	(-4.15)	(-4.15)
lnsig2u						
Constant	-8.721	-0.515	-0.775	-0.448	-0.795	-0.787
	(-0.03)	(-0.71)	(-1.26)	(-0.66)	(-1.27)	(-1.27)
Observations	964	3442	4734	3746	4734	4734
Log Likelihood	-46.47	-213.68	-388.87	-258.91	-388.79	-387.60

t statistics in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 24: Grievance model: Random-effects logistic regression for civil war's onset 1970-2007

	(1) civilwar_onset	(2) civilwar_onset	(3) civilwar_onset	(4) civilwar_onset	(5) civilwar_onset
civilwar_onset					
fe_etfra	2.890***	2.581	3.159***	1.510	3.135***
	(2.64)	(1.22)	(2.82)	(1.02)	(2.79)
al_religion	-0.0358	-0.253			
	(-0.06)	(-0.22)			
eth_major	1.189**	0.346	1.374***	0.815	1.368***
	(2.41)	(0.36)	(2.61)	(1.17)	(2.59)
p_polity	-0.0174***	-0.0233**	-0.0126***	-0.00494	-0.0125***
	(-4.70)	(-2.17)	(-3.11)	(-0.73)	(-3.08)
p_durable	-0.0195***	-0.0277*	-0.0194***	-0.0214*	-0.0189***
	(-2.83)	(-1.69)	(-2.68)	(-1.91)	(-2.61)
Poplog2	0.282***	0.436***	0.314***	0.585***	0.309***
	(3.30)	(2.88)	(3.53)	(4.84)	(3.47)
uw_gini		-0.0460*			
		(-1.78)			
h_polcon5			-1.223***	-0.975*	-1.262***
			(-2.72)	(-1.68)	(-2.79)
dbagdp				-0.0214**	
				(-2.14)	
L5.FinDummy					0.354
					(1.06)
Constant	-10.57***	-10.78***	-11.05***	-14.05***	-10.99***
	(-6.53)	(-3.38)	(-6.51)	(-6.20)	(-6.47)
lnsig2u					
Constant	-0.739	-11.57	-0.572	-0.632	-0.563
	(-1.41)	(-0.03)	(-1.19)	(-0.87)	(-1.18)
Observations	4766	1444	4726	3499	4726
Log Likelihood	-484.96	-83.99	-482.90	-272.80	-482.38

t statistics in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 25: Combined model: Random-effects logistic regression for civil war's onset 1970-2007

	(1) civilwar_onset	(2) civilwar_onset	(3) civilwar_onset	(4) civilwar_onset	(5) civilwar_onset
civilwar_onset					
TX_VAL_FUEL_ZS_UN	-0.00154				
	(-0.06)				
FuelSqr	0.0000347				
	(0.12)				
GDPcaplog2	-0.587***	-0.251**	-0.290	-0.250**	-0.262**
	(-2.91)	(-2.04)	(-1.64)	(-2.02)	(-2.02)
GDPgrowth2	-0.0785***	-0.0678***	-0.0137	-0.0698***	-0.0669***
	(-2.62)	(-4.92)	(-0.52)	(-5.03)	(-4.55)
p_durable	-0.0207	-0.0198**	-0.0230*	-0.0188**	-0.0162*
	(-1.51)	(-2.12)	(-1.71)	(-2.03)	(-1.77)
Poplog2	0.465***	0.374***	0.612***	0.368***	0.364***
	(3.29)	(4.04)	(4.75)	(3.95)	(3.82)
fe_etfra	0.361	1.490	0.427	1.424	1.297
	(0.22)	(1.26)	(0.28)	(1.20)	(1.07)
al_religion	-1.098				
	(-1.16)				
eth_major	0.668	0.715	0.532	0.688	0.662
	(0.84)	(1.27)	(0.72)	(1.21)	(1.14)
p_polity	-0.0114	-0.00781	-0.00390	-0.00721	-0.00765
	(-1.58)	(-1.60)	(-0.55)	(-1.46)	(-1.50)
h_polcon5		-0.578	-0.582	-0.639	-0.538
		(-1.17)	(-0.96)	(-1.27)	(-1.05)
dbagdp			-0.0237*		
			(-1.95)		
L5.FinDummy				0.605*	
				(1.77)	
L5.FinGDPgrowth2					-0.0887***
					(-3.10)
Constant	-7.726**	-9.205***	-11.80***	-9.128***	-8.909***
	(-2.54)	(-4.49)	(-4.34)	(-4.44)	(-4.21)
lnsig2u					
Constant	-0.608	-1.104	-0.867	-1.071	-1.083
	(-0.79)	(-1.43)	(-0.93)	(-1.43)	(-1.42)
Observations	3079	4198	3301	4198	3977
Log Likelihood	-202.99	-362.41	-245.66	-361.00	-341.54

t statistics in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 26: African model for civil war's onset 1970-2007

	(1) onset_Africa	(2) onset_Africa	(3) onset_Africa	(4) onset_Africa	(5) onset_Africa	(6) onset_Africa
onset_Africa						
TX_VAL_FUEL_ZS_UN	-0.0459					
	(-0.60)					
FuelSqr	0.000614					
	(0.85)					
GDPcaplog2	-1.158	-0.333	-0.420*	-0.368	-0.273	0.178
	(-1.56)	(-1.37)	(-1.78)	(-1.54)	(-1.13)	(0.50)
GDPgrowth2	-0.0858	-0.0337	-0.0332	-0.0367*	-0.0413**	-0.0580**
	(-1.39)	(-1.64)	(-1.63)	(-1.79)	(-2.09)	(-1.99)
p_durable	-0.110*	-0.0159				
	(-1.66)	(-0.94)				
Poplog2	0.827	0.417**	0.429**	0.405**	0.424**	0.733***
	(1.55)	(2.32)	(2.43)	(2.27)	(2.31)	(2.69)
fe_etfra	-7.782	0.600				
	(-1.41)	(0.25)				
al_religion	0.276					
	(0.15)					
eth_major	-1.903	0.499				
	(-0.74)	(0.39)				
p_polity	-0.0106	-0.0122*	-0.0139**	-0.0124**	-0.0132**	-0.0128
	(-0.97)	(-1.92)	(-2.36)	(-2.06)	(-2.20)	(-1.62)
h_polcon5		-0.366				
		(-0.45)				
L5.FinDummy				0.961**		
				(2.21)		
L5.FinGDPgrowth2					-0.115***	-0.152***
					(-3.09)	(-2.85)
L.dbagdp						-0.0385*
						(-1.72)
Constant	-4.923	-8.880**	-8.294**	-8.367**	-9.236***	-16.72***
	(-0.46)	(-2.45)	(-2.54)	(-2.51)	(-2.70)	(-3.07)
lnsig2u						
Constant	-13.75	-1.038	-0.814	-0.687	-0.700	-0.348
	(-0.03)	(-0.82)	(-0.77)	(-0.72)	(-0.72)	(-0.36)
Observations	825	1534	1641	1641	1566	1163
Log Likelihood	-42.65	-167.17	-173.21	-171.05	-161.88	-103.81

t statistics in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 27: Asian model for civil war's onset 1970-2007

	(1) onset_Asia	(2) onset_Asia	(3) onset_Asia	(4) onset_Asia	(5) onset_Asia	(6) onset_Asia	(7) onset_Asia
onset_Asia							
TX_VAL_FUEL_ZS_UN	0.0485						
	(1.05)						
FuelSqr	-0.000647						
	(-1.11)						
GDPcaplog2	-0.499*	-0.0110	-0.288	-0.295*	-0.305*	-0.205	-0.198
	(-1.66)	(-0.06)	(-1.63)	(-1.70)	(-1.79)	(-1.21)	(-1.08)
GDPgrowth2	-0.0289	-0.0940***	-0.0971***	-0.0930***	-0.0966***	-0.0851***	-0.102***
	(-0.47)	(-4.40)	(-4.89)	(-4.56)	(-4.92)	(-3.71)	(-4.06)
p_durable	-0.00914	-0.0174					
	(-0.49)	(-1.29)					
Poplog2	0.243	0.390***	0.352**	0.336**	0.325**	0.351**	0.391**
	(1.29)	(2.76)	(2.49)	(2.42)	(2.42)	(2.53)	(2.56)
fe_etfra	0.556	1.419					
	(0.25)	(0.79)					
al_religion	-1.205						
	(-0.69)						
eth_major	0.454	0.494					
	(0.41)	(0.64)					
p_polity	0.0561	0.0117					
	(1.27)	(0.77)					
h_polcon5		-0.355					
		(-0.44)					
FinDummy				0.456			
				(0.78)			
L2.FinDummy					1.321**	1.106**	
					(2.56)	(2.09)	
NE_GDI_TOTL_ZS						-0.0542*	-0.0636**
						(-1.95)	(-2.05)
L2.FinGDPgrowth2							0.00793
							(0.15)
Constant	-4.500	-10.69***	-7.654**	-7.344**	-7.144**	-6.972**	-7.445**
	(-0.93)	(-2.89)	(-2.50)	(-2.45)	(-2.46)	(-2.41)	(-2.33)
Insig2u							
Constant	-1.534	-1.833	-0.655	-0.797	-0.962	-1.261	-0.778
	(-0.70)	(-0.77)	(-0.73)	(-0.80)	(-0.86)	(-0.95)	(-0.81)
Observations	777	1071	1328	1328	1328	1250	1204
Log Likelihood	-88.71	-126.13	-144.79	-144.51	-142.11	-137.17	-133.79

t statistics in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 28: Onset of civil war for government control 1970-2007

	(1) GovControlOnset	(2) GovControlOnset	(3) GovControlOnset	(4) GovControlOnset	(5) GovControlOnset	(6) GovControlOnset
GovControlOnset						
TX_VAL_FUEL_ZS_UN	-0.0166					
	(-0.38)					
FuelSqr	0.000190					
	(0.41)					
GDPcaplog2	-0.634**	-0.294**	-0.291**	-0.270**	-0.247*	-0.0784
	(-2.44)	(-2.08)	(-2.20)	(-2.05)	(-1.79)	(-0.34)
GDPgrowth2	-0.0887**	-0.0631***	-0.0643***	-0.0679***	-0.0637***	-0.0720***
	(-2.48)	(-4.24)	(-4.42)	(-4.62)	(-4.08)	(-2.78)
p_durable	-0.0275	-0.0240*	-0.0239*	-0.0228*	-0.0218	-0.0407*
	(-1.25)	(-1.69)	(-1.73)	(-1.67)	(-1.58)	(-1.77)
Poplog2	-0.0358	0.0116				
	(-0.19)	(0.10)				
fe_etfra	-0.830	0.731				
	(-0.43)	(0.55)				
aLreligion	-0.883					
	(-0.74)					
eth_major	0.963	0.716				
	(0.98)	(1.11)				
p_polity	-0.0197***	-0.0165***	-0.0148***	-0.0140***	-0.0137***	-0.0123*
	(-2.64)	(-3.27)	(-2.89)	(-2.82)	(-2.60)	(-1.72)
h_polcon5		-1.063	-1.161*	-1.248*	-1.325*	-1.254
		(-1.51)	(-1.67)	(-1.79)	(-1.86)	(-1.35)
L5.FinDummy				0.779*		
				(1.89)		
L5.FinGDPgrowth2					-0.0960***	-0.0926**
					(-3.18)	(-2.27)
L.dbagdp						-0.0309*
						(-1.69)
Constant	0.736	-2.979	-2.066**	-2.271***	-2.349**	-3.081**
	(0.18)	(-1.31)	(-2.34)	(-2.60)	(-2.54)	(-2.07)
lnsig2u						
Constant	-2.096	-11.67	-3.601	-15.01	-3.233	-0.255
	(-0.36)	(-0.38)	(-0.31)	(-0.00)	(-0.35)	(-0.27)
Observations	3079	4196	4652	4652	4395	3513
Log Likelihood	-109.05	-227.99	-240.45	-238.90	-229.20	-145.33

t statistics in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 29: Onset of civil war fought over local issues 1970-2007

	(1) LocalIssueOnset	(2) LocalIssueOnset	(3) LocalIssueOnset	(4) LocalIssueOnset	(5) LocalIssueOnset	(6) LocalIssueOnset
LocalIssueOnset						
TX_VAL_FUEL_ZS_UN	0.0567					
	(1.31)					
FuelSqr	-0.000690					
	(-1.29)					
GDPcaplog2	-0.628*	-0.165	-0.392**	-0.394**	-0.390**	-0.367*
	(-1.69)	(-0.69)	(-2.09)	(-2.10)	(-2.06)	(-1.86)
GDPgrowth2	0.00274	-0.0786***	-0.0789***	-0.0771***	-0.0794***	-0.0826***
	(0.04)	(-3.02)	(-3.30)	(-3.14)	(-3.26)	(-3.21)
p_durable	-0.0162	-0.0260				
	(-0.80)	(-1.60)				
Poplog2	0.758***	0.715***	0.713***	0.709***	0.705***	0.752***
	(2.73)	(4.02)	(4.20)	(4.18)	(4.13)	(4.14)
fe_etfra	3.025	2.200				
	(0.97)	(0.99)				
al_religion	-2.395					
	(-1.27)					
eth_major	1.349	1.103				
	(0.90)	(1.01)				
p_polity	0.0814*	0.0285				
	(1.67)	(1.32)				
h_polcon5		-0.591				
		(-0.69)				
FinDummy				0.198		
				(0.33)		
L2.FinDummy					1.079**	
					(2.13)	
L2.FinGDPgrowth2						-0.0503
						(-0.91)
Constant	-15.97**	-17.49***	-14.97***	-14.90***	-15.00***	-15.95***
	(-2.48)	(-4.17)	(-4.62)	(-4.61)	(-4.62)	(-4.61)
lnsig2u						
Constant	0.588	0.263	0.528	0.517	0.542	0.612
	(0.76)	(0.37)	(0.89)	(0.87)	(0.90)	(1.04)
Observations	3079	4198	6006	6006	6006	5821
Log Likelihood	-99.60	-149.73	-159.52	-159.47	-157.59	-149.02

t statistics in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 30: HIPC model for civil war's onset 1970-2007

	(1) HIPCOnset	(2) HIPCOnset	(3) HIPCOnset	(4) HIPCOnset	(5) HIPCOnset	(6) HIPCOnset
HIPCOnset						
TX_VAL_FUEL_ZS_UN	-0.0107					
	(-0.05)					
FuelSqr	-0.00238					
	(-0.21)					
GDPcaplog2	-0.0911	-0.542*	-0.589*	-0.484	-0.502	-0.383
	(-0.13)	(-1.69)	(-1.92)	(-1.57)	(-1.60)	(-1.24)
GDPgrowth2	-0.144**	-0.0536**	-0.0512**	-0.0618***	-0.0619***	-0.0584***
	(-2.28)	(-2.42)	(-2.49)	(-2.86)	(-2.87)	(-2.77)
p_durable	0.0284	0.00348				
	(0.79)	(0.22)				
Poplog2	1.767**	0.131				
	(2.54)	(0.55)				
fe_etfra	-4.055	3.201				
	(-0.82)	(1.25)				
al_religion	3.037					
	(0.86)					
eth_major	1.639	2.872**	1.107**	1.188***	1.143**	1.277***
	(0.60)	(2.04)	(2.44)	(2.58)	(2.47)	(2.71)
p_polity	-0.0171	-0.0169**	-0.0181***	-0.0152**	-0.0149**	-0.0185***
	(-1.30)	(-2.16)	(-2.78)	(-2.24)	(-2.18)	(-2.72)
h_polcon5		0.426				
		(0.41)				
L4.FinDummy				1.301**		
				(2.56)		
L5.FinDummy					1.308**	
					(2.57)	
L5.FinGDPgrowth2						-0.110***
						(-2.66)
Constant	-31.92**	-5.887	-0.849	-1.668	-1.538	-2.295
	(-2.22)	(-1.23)	(-0.46)	(-0.88)	(-0.80)	(-1.21)
lnsig2u						
Constant	-14.05	-13.07	-12.30	-12.30	-12.94	-12.99
	(-0.02)	(-0.39)	(-0.38)	(-0.38)	(-0.39)	(-0.39)
Observations	633	1106	1107	1107	1107	1070
Log Likelihood	-33.75	-103.95	-105.45	-102.65	-102.64	-94.61

t statistics in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 31: PRIO combined model: Random-effects logistic regression for civil war's onset 1970-2007

	(1) Prio_Onset_all	(2) Prio_Onset_all	(3) Prio_Onset_all	(4) Prio_Onset_all	(5) Prio_Onset_all	(6) Prio_Onset_all
Prio_Onset_all						
GDPcaplog2	-0.198	-0.257**	-0.145	-0.249**	-0.242**	-0.238*
	(-1.47)	(-2.10)	(-0.81)	(-2.02)	(-1.96)	(-1.93)
GDPgrowth2	-0.0651***	-0.0740***	-0.0686**	-0.0667***	-0.0678***	-0.0614***
	(-3.97)	(-4.70)	(-2.20)	(-4.09)	(-4.21)	(-3.31)
p_durable	-0.00859					
	(-0.99)					
Poplog2	0.393***	0.428***	0.680***	0.424***	0.425***	0.432***
	(4.13)	(4.68)	(4.87)	(4.60)	(4.60)	(4.69)
fe_etfra	0.883					
	(0.75)					
eth_major	0.858					
	(1.43)					
p_polity	-0.00645					
	(-1.01)					
h_polcon5	-1.102*	-1.460**	-1.324*	-1.537**	-1.570**	-1.582**
	(-1.80)	(-2.40)	(-1.83)	(-2.50)	(-2.54)	(-2.55)
dbagdp			-0.0272**			
			(-2.09)			
FinDummy				0.938***		
				(2.58)		
L.FinDummy					1.017***	
					(2.81)	
FinGDPgrowth2						-0.0514
						(-1.63)
Constant	-9.989***	-9.338***	-13.83***	-9.431***	-9.513***	-9.544***
	(-4.73)	(-5.07)	(-5.00)	(-5.11)	(-5.15)	(-5.14)
lnsig2u						
Constant	-9.078	-2.438	-1.778	-2.413	-2.336	-2.358
	(-0.41)	(-0.88)	(-0.79)	(-0.88)	(-0.90)	(-0.93)
Observations	4198	4967	3936	4967	4967	4967
Log Likelihood	-247.16	-259.99	-166.66	-257.13	-256.66	-258.75

t statistics in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 32: Penn World Tables combined model: Random-effects logistic regression for civil war's onset 1970-2007

	(1) civilwar_onset	(2) civilwar_onset	(3) civilwar_onset	(4) civilwar_onset	(5) onset_Africa	(6) onset_Asia	(7) HIPCOnset
main							
GDPcaplog3	-0.325**	-0.370	-0.323**	-0.404**	-0.550*	-0.490***	-0.366
	(-2.06)	(-1.64)	(-2.04)	(-2.53)	(-1.93)	(-2.68)	(-0.98)
GDPgrowth3	-0.0375***	-0.00768	-0.0379***	-0.0306**	-0.0431**	-0.0441***	-0.0437**
	(-3.12)	(-0.35)	(-3.17)	(-2.43)	(-2.37)	(-2.59)	(-2.44)
p_durable	-0.0149**	-0.0223*	-0.0144*	-0.0116			
	(-1.98)	(-1.82)	(-1.92)	(-1.57)			
Poplog3	0.356***	0.584***	0.353***	0.362***	0.469***	0.266***	
	(3.97)	(5.15)	(3.93)	(4.14)	(2.87)	(2.67)	
fe_etfra	2.543**	0.738	2.493**	2.049*			
	(2.27)	(0.49)	(2.21)	(1.89)			
eth_major	1.350**	0.761	1.334**	1.023*			1.132**
	(2.46)	(1.05)	(2.42)	(1.89)			(2.05)
p_polity	-0.00885*	-0.00447	-0.00856*	-0.00846*	-0.0108*		-0.0167***
	(-1.95)	(-0.64)	(-1.88)	(-1.81)	(-1.82)		(-2.66)
h_polcon5	-0.856*	-0.649	-0.907*	-0.901*			
	(-1.73)	(-1.10)	(-1.82)	(-1.75)			
dbagdp		-0.0219*					
		(-1.89)					
L5.FinDummy			0.381		0.808*		1.022**
			(1.08)		(1.89)		(2.02)
L2.FinDummy						1.350***	
						(2.75)	
L5.FinGDPgrowth3				-0.0624**			
				(-2.09)			
Constant	-6.421***	-6.501***	-6.411***	-5.463***	-4.310*	-2.348	-1.723
	(-3.60)	(-2.76)	(-3.58)	(-3.15)	(-1.65)	(-1.26)	(-0.64)
lnsig2u							
Constant	-1.011	-1.738	-0.979	-1.543	-1.183	-2.269	-1.430
	(-1.41)	(-0.89)	(-1.41)	(-1.59)	(-0.98)	(-0.86)	(-0.85)
Observations	4029	2997	4029	3796	1573	1387	1050
Log Likelihood	-402.07	-239.53	-401.52	-389.25	-176.97	-162.37	-126.30

t statistics in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 33: Hyperinflation and civil war's onset 1970-2007

	(1) civilwar_onset	(2) onset_Africa	(3) onset_Asia	(4) LowOnset	(5) HIPCOnset	(6) GovControlOnset
main						
GDPcaplog2	-0.244**	-0.401	-0.299*			-0.276**
	(-1.98)	(-1.64)	(-1.69)			(-2.09)
GDPgrowth2	-0.0685***	-0.0346*	-0.0966***	-0.0548***	-0.0594***	-0.0660***
	(-4.96)	(-1.67)	(-4.87)	(-2.90)	(-2.85)	(-4.53)
p_durable	-0.0193**					-0.0224
	(-2.08)					(-1.64)
Poplog2	0.376***	0.396**	0.342**			
	(4.04)	(2.16)	(2.42)			
fe_etfra	1.443					
	(1.22)					
eth_major	0.680			0.771*	1.049**	
	(1.20)			(1.95)	(2.31)	
p_polity	-0.00753	-0.0118*		-0.0172***	-0.0215***	-0.0144***
	(-1.53)	(-1.94)		(-2.83)	(-3.55)	(-2.83)
h_polcon5	-0.608					-1.228*
	(-1.22)					(-1.76)
L4.HyperInf_all	0.648	2.258**		1.448*	1.459*	1.253*
	(0.98)	(2.45)		(1.67)	(1.77)	(1.91)
oL4.HyperInf_all			0			
			(.)			
Constant	-9.248***	-7.963**	-7.385**	-3.946***	-4.447***	-2.196**
	(-4.49)	(-2.33)	(-2.41)	(-14.41)	(-14.96)	(-2.48)
lnsig2u						
Constant	-1.084	-0.572	-0.681	-11.82	-12.20	-5.028
	(-1.44)	(-0.67)	(-0.75)	(-0.37)	(-0.38)	(-0.10)
Observations	4198	1641	1307	958	1107	4652
Log Likelihood	-362	-170.56	-144.26	-126.70	-106.25	-239.04

t statistics in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 34: African banking crises and civil war 1970-2007

#	Country	Civil War	Type	Banking Crisis	HIPC
1	Ethiopia	Eritrean Split (1972-1974)	Intercommunal		Yes
2	Burundi	First Burundi (1972)	Government Control		Yes
3	Zimbabwe	Rhodesia (1972-1979)	Government Control		
4	Eritrea	Eritrean War (1975-1978)	Local Issues		
5	Angola	Angolan Control (1976-1991)	Government Control		
6	Ethiopia	Second Ogaden Phase 1 (1976-1977)	Local Issues		Yes
7	Ethiopia	Second Ogaden Phase 3 (1978-1980)	Local Issues		Yes
8	Congo, Dem. Rep.	Fourth DRC (Shaba) (1978)	Government Control		Yes
9	Mozambique	Mozambique (1979-1992)	Government Control		Yes
10	Chad	Second Chad (Habre Revolt) (1980-1984)	Local Issues		
11	Uganda	Second Uganda (1980-1986)	Local Issues		Yes
12	Nigeria	Nigeria-Muslim (1980-1981)	Local Issues		
13	Ethiopia	Tigrean and Eritrean (1982-1991)	Local Issues		Yes
14	Zimbabwe	Matabeleland (1983-1987)	Government Control		
15	Sudan	Second South Sudan (1983-1991)	Government Control		
16	Uganda	Holy Spirit Movement (1986-1987)	Government Control		Yes
17	South Africa	Inkatha-ANC (1987-1994)	Intercommunal		
18	Somalia	First Somalia (1988-1991)	Government Control		
19	Chad	Third Chad (Deby Coup) (1989-1990)	Government Control		
20	Liberia	First Liberia (1989-1990)	Government Control		Yes
21	Sierra Leone	First Sierra Leone (1991-1996)	Government Control	(1990-1994)	Yes
22	South Sudan	The SPLA Division (Dinka-Nuer) War (1991-1992)	Intercommunal		
23	Nigeria	Jukun-Tiv War (1991-1992)	Intercommunal	(1991-1995)	
24	Somalia	Second Somalia (1991-1997)	Government Control		
25	Algeria	Algerian Islamic Front (1992-1999)	Government Control	(1990-1994)	
26	Liberia	Second Liberia (1992-1995)	Government Control	(1991-1995)	Yes
27	Angola	Angolan War of the Cities (1992-1994)	Government Control		
28	Burundi	Second Burundi (1993-1998)	Government Control		Yes
29	Rwanda	Second Rwanda (1994)	Government Control		Yes
30	Liberia	Third Liberia (1996)	Government Control	(1991-1995)	Yes
31	Congo, Dem. Rep.	Fifth DRC (1996-1997)	Government Control	(1991-1994) (1994-1998)	Yes
32	Rwanda	Third Rwanda (1997-1998)	Government Control		Yes
33	Congo, Rep.	First Congo (Brazzaville) (1997)	Government Control	(1992-1994)	Yes
34	Sierra Leone	Second Sierra Leone (1998-2000)	Government Control	(1990-1994)	Yes
35	Guinea-Bissau	Guinea-Bissau Military (1998-1999)	Government Control	(1995-1998)	Yes
36	Congo, Dem. Rep.	Africa's World War (1998-2002)	Government Control	(1994-1998)	Yes
37	Chad	Fourth Chad (Togoimi Revolt) (1998-2000)	Government Control	(1992-1996)	
38	Angola	Third Angolan (1998-2002)	Government Control		
39	Congo, Rep.	Second Congo (Brazzaville) (1998-1999)	Government Control	(1992-1994)	Yes
40	Nigeria	First Nigeria Christian-Muslim (1999-2000)	Intercommunal	(1991-1995)	
41	Ethiopia	Oromo Liberation (1999)	Local Issues		Yes
42	Guinea	Guinean (2000-2001)	Government Control		Yes
43	Burundi	Third Burundi (2001-2003)	Government Control	(1994-1998)	Yes
44	Rwanda	Fourth Rwanda (2001)	Government Control		Yes
45	Liberia	Fourth Liberian (2002-2003)	Government Control		Yes
46	Ethiopia	Ethiopian Anyuaa-Nuer (2002-2003)	Intercommunal		Yes
47	Cote d'Ivoire	Cote d'Ivoire Military (2002-2004)	Government Control		Yes
48	Sudan	Darfur (2003-2006)	Local Issues		
49	Nigeria	Second Nigeria Christian-Muslim (2004)	Intercommunal		
50	Chad	Fifth Chad (2005-2006)	Government Control		
51	Somalia	Third Somalia (2006-2008)	Government Control		

Table 35: Asian banking crises and civil war 1970-2007

#	Country	Civil War	Type	Banking Crisis	HIPC
1	India	Naxalite Rebellion (1970-1971)	Local Issues		
2	Jordan	Black September (1970)	Government Control		
3	Pakistan	Pakistan-Bengal (1971)	Local Issues		
4	Sri Lanka	First Sri Lanka-JVP (1971)	Government Control		
5	Cambodia	Khmer Rouge (1971-1975)	Government Control		
6	Phillipines	First Philippine-Moro (1972-1981)	Local Issues		
7	Thailand	Communist Insurgency (1972-1973)	Government Control		
8	Phillipines	Philippines-NPA (1972-1992)	Government Control		
9	Pakistan	Baluchi Separatists (1973-1977)	Local Issues		
10	Oman	Dhofar Rebellion Phase 2 (1973-1975)	Local Issues		
11	Oman	Dhofar Rebellion Phase 3 (1973-1975)	Local Issues		
12	Iraq	Fourth Iraqi Kurds (1974-1975)	Local Issues		
13	Lebanon	Second Lebanese (1975-1976)	Intercommunal		
14	Lao PDR	Third Laotian (1976-1979)	Local Issues		
15	East Timor	East Timorese War Phase 3 (1976-1979)	Local Issues		
16	Lebanon	Third Lebanese (1978)	Intercommunal		
17	Afghanistan	Saur Revolution (1978)	Government Control		Yes
18	Afghanistan	First Afghan Mujahideen Uprising (1978-1980)	Government Control		Yes
19	Iran	Overthrow of the Shah (1978-1979)	Government Control		
20	Iran	Anti-Khomeini Coalition (1979-1984)	Government Control		
21	Syria	Hama (1981-1982)	Government Control		
22	Burma/Myanmar	Fourth Burmese (1983-1988)	Local Issues		
23	Lebanon	Fourth Lebanese Civil (1983-1984)	Government Control		
24	Sri Lanka	First Sri Lanka Tamil (1983-2002)	Local Issues		
25	India	Indian Golden Temple (1984)	Local Issues		
26	Turkey	First Turkish Kurds (1984-1986)	Local Issues	(1982-1984)	
27	Iraq	Fifth Iraqi Kurds (1985-1988)	Local Issues		
28	South Yemen	South Yemen (1986)	Government Control		
29	Sri Lanka	Second Sri Lanka-JVP (1987-1989)	Government Control		
30	Burma/Myanmar	Fifth Burmese (1988)	Government Control		
31	Lebanon	Fifth Lebanese (1989-1990)	Government Control		
32	Afghanistan	Second Afghan Mujahideen Uprising (1989-2001)	Government Control		Yes
33	Indonesia	First Aceh (1989-1991)	Local Issues		
34	Cambodia	First Cambodian Civil War (1989-1991)	Government Control		
35	India	Kashmir Insurgents (1990-2005)	Local Issues		
36	Iraq	Shiite and Kurdish (1991)	Local Issues		
37	Turkey	Second Turkish Kurds (1991-1999)	Local Issues		
38	Georgia	Georgia (1991-1992)	Government Control	(1991-1995)	
39	Azerbaijan	Nagorno-Karabakh (1991-1993)	Local Issues		
40	Tajikistan	Tajikistan (1992-1997)	Government Control		
41	Cambodia	Second Cambodia Civil (1993-1997)	Government Control		
42	Georgia	Abkhazia Revolt (1993-1994)	Local Issues	(1991-1995)	
43	South Yemen	South Yemeni Secessionist (1994)	Local Issues		
44	Russia	First Chechnya (1994-1996)	Local Issues		
45	Iraq	Iraqi Kurd Internecine (1994-1995)	Intercommunal		
46	Iraq	Sixth Iraqi Kurds (1996)	Local Issues		
47	Indonesia	Moluccas Sectarian (1999-2000)	Intercommunal	(1997-2001)	
48	Indonesia	Second Aceh (1999-2002)	Local Issues	(1997-2001)	
49	Russia	Second Chechen (1999-2003)	Local Issues	1998	
50	Phillipines	Second Philippine-Moro (2000-2001)	Local Issues	(1997-2001)	
51	Nepal	First Nepal Maoist Insurgency (2001-2003)	Government Control		
52	Phillipines	Third Philippine-Moro (2003)	Local Issues	(1997-2001)	
53	Indonesia	Third Aceh (2003)	Local Issues	(1997-2001)	
54	Nepal	Second Nepal Maoists (2003-2006)	Government Control		
55	Pakistan	Waziristan (2004-2006)	Local Issues		
56	Yemen	First Yemeni Cleric (2004-2005)	Government Control		
57	Phillipines	Philippine Joint Offensive (2005-2006)	Local Issues	(1997-2001)	
58	Sri Lanka	Second Sri Lanka Tamil (2006-current*)	Local Issues		
59	Northern Yemen	Second Yemeni Cleric (2007)	Government Control		

Table 36: All other banking crises and civil war 1970-2007

#	Country	Civil War	Type	Banking Crisis	HIPC
1	Guatemala	Second Guatemala (1970-1971)	Government Control		
2	Chile	Chilean Coup of 1973 (1973)	Government Control		
3	Argentina	Argentine Leftists (1975-1977)	Government Control		
4	Papua New Guinea	Second West Papua (1976-1978)	Local Issues		
5	Guatemala	Third Guatemala (1978-1984)	Government Control		
6	Nicaragua	Sandinista Rebellion (1978-1979)	Government Control		Yes
7	El Salvador	El Salvador (1979-1992)	Government Control		
8	Peru	Shining Path (1982-1992)	Government Control		
9	Nicaragua	Contra War (1982-1990)	Government Control		Yes
10	Papua New Guinea	Bougainville Secession (1989-1992)	Local Issues		
11	Colombia	Eighth Colombia (1989-current*)	Local Issues		
12	Romania	Romania (1989)	Government Control		
13	Croatia	Croatian Independence (1991-1992)	Local Issues		
14	Moldova	Dniestrian Independence (1991-1992)	Local Issues		
15	Bosnia	Bosnian-Serb Rebellion (1992-1995)	Local Issues	(1992-1996)	
16	Croatia	Bosnian-Serb Rebellion (1992-1994)	Local Issues		
17	Croatia	Croatia-Krajina War (1995)	Local Issues		
18	Kosovo	Kosovo Independence (1998-1999)	Local Issues		

CHAPTER 3

CIVIL WAR SEVERITY AND THE ECONOMY

3.1 Introduction

Studying the determinants of war's severity has practical importance in terms of government policy decisions and their implications for future economic growth. If the effects of war can be ameliorated through decisive government action, then this seems to be a beneficial option for all parties involved. The economic theories of conflict revolve around opportunity costs associated with rebellion such that when the opportunity cost of joining a rebellion is sufficiently low, then the potential rebel has economic incentive to cause strife. Therefore, if the opportunity costs of war rise through the effect of development assistance and aid, employment, and stable prices, then people will abstain from conflict activities and the effects of war will be less severe.

This paper addresses the question of what drives the severity of civil war and what policy decisions may be taken to ameliorate the detrimental effects of war. Severity is measured by average civil war battle deaths per year and determined according to political and economic variables commonly associated with conflict such as aid, unemployment, and hyperinflation. Lacina (2006) uses civil war duration, but does not account for endogeneity with civil war severity. Therefore, the main estimation procedure of this paper is generalized method of moment estimation with an instrumental variable to account for the endogeneity of civil war's duration in determining war's severity. Economic variables associated with war such as aid,

unemployment, and hyperinflation are included as explanatory variables and provide a basis for government policy decisions during the civil war.

The economic theories of civil war outlined in Collier and Hoeffler (2004) are critical in understanding the contribution of this paper. Opportunity costs, diminishing wealth, and potential benefits of looting explain the motivations for civil strife. The first estimation of civil war's severity from Lacina (2006) involves ordinary least squares regression techniques that find civil war's duration, the end of the cold war, levels of democracy, and ethnic polarization to be significant predictors of a civil war's severity. However, the duration of war and its severity may endogenously determine one another[31]. Another issue which is not addressed in Lacina (2006) is the time-varying nature of civil war's severity.

This paper explains the severity of war in economic terms by analyzing the effect of aid, unemployment and hyperinflation. These variables have often been associated with war, but they've never explicitly been used to determine the severity of war. This paper considers a panel time-series estimation with instrumental variables instead of the first proposed ordinary least squares. This estimation captures annual changes in war severity by country and controls for a possible endogeneity problem with the

[31] Also, in practical terms, government policy which shortens a war will also make it less severe which leads to the question of what can shorten a civil war? Or how can a government become more democratic? The answer may be the civil war itself which cannot help diminish war severity.

duration of war. Concluding remarks suggest possible government policy for a practical amelioration of severe conflict.

The literature related to civil war's severity is first summarized with attention to motivations behind the inclusion of certain variables. The construction of severity is then explained and followed by a description of the predictors of these average annual battle deaths. The model and results using IV/GMM estimation precedes the conclusion which entails a short description of possible government policy to decrease a civil war's severity.

3.2 Literature review

3.2.1 Conflict literature related to civil war’s severity

The summary of literature related to civil war's severity is relatively short (Lacina and Gleditsch, 2005) in comparison to civil war's duration and onset, but the point of departure must be Lacina (2006). Lacina (2006) estimates state-based armed conflicts as specified from the Uppsala/PRIO database with ordinary least squares. In this research each conflict occurrence and the related battle deaths exist as single data points which amount to at most 114 observations. However, the severity of war may change over time with the introduction of international participants, new sources of government wealth, and changes to the economic well-being of active participants.

Civil war's severity can be measured in different contexts such as conventional and irregular warfare in Balcells and Kalyvas (2014). Here they suggest the "technology of rebellion" is important as civil war is not only a political contest, but a military contest as well. One important takeaway from Balcells and Kalyvas (2014) is their measure of

average battle deaths per month which suggests that averaging battle deaths is a valid tool for understanding conflict's severity.[32]

The onset and severity of conflict can be estimated together since they "are distinct but interconnected decisions and should be estimated as such" (Ritter 2014). In Ritter (2014) a relationship between political survival and repression and dissent is estimated using Tobit regression techniques. She finds that a secure leader is likely to pursue peaceful governance until conflict begins and the governing leader escalates conflict along with the rebel party - thus increasing conflict's severity. In any case, the inter-relationship between conflict's onset and severity is central to this paper's proposed estimation model.

3.2.2 The relationship between unemployment and civil war

Several development factors influence the motivations for war such as growth, infant mortality, and unemployment Buhaug and Lujala (2013). However, Buhaug and Lujala (2013) suggest that such aspects "should be measured at a sub-national level" since data organized by country cannot approximate conflict zones as accurately. They address this problem, but if a civil war is sufficiently severe, then changes in unemployment will be noticeable with country-level data which is used in this paper.

Hartzell, Hoddie and Rothchild (2001) explain the cumulative nature of "poverty, unemployment, land pressures, [an] inadequate tax base, [a] lack of education, and insufficient or unavailable human skills" which operate as government constraints to

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[32] A monthly specification of conflict's duration is common using survival analysis.

regulation and social compliance. This government weakness to resolve such issues "heightens insecurity" (Hartzell, Hoddie and Rothchild, 2001). Unemployment contributes to this insecurity although it is often absent in typical estimations of civil war due to the reasons listed previously.

3.2.3 The role of debt and aid in civil war

Debt relief can play a crucial role in addressing "past neglect and discrimination" as inequality in government spending can cause social grievances (Addison and Murshed, 2003). Highly-indebted poor countries have weak social contracts such that a collapse of the contract and ensuing civil war will be related to "favouritism in public spending" and unjust taxation (Addison and Murshed, 2003). The effects of debt relief and development aid, our variable of interest, are strongly positive during and after a civil war.[33]

3.3 Civil war deaths

The severity of war in Lacina (2006) is measured by the number of combatant and civilian battle deaths incurred by both sides in a given year. In a time series regression, the battle deaths must be recorded for each year in a meaningful way. The Correlates of War database records the total number of combatant battle deaths for both sides over the course of the civil war, not the deaths incurred per year. Given this

[33] However, aid and debt relief in general to African countries has been suggested to have a negative effect on development in Kanbur (2000) and food aid from the U.S. may have a positive effect on the incidence, onset and duration of civil war in Nunn and Qian (2011).

method of data collection, and the fact that regression analysis reports coefficients for an average country in an average year, it makes sense to use average battle deaths[34].

The years without battle deaths receive a "0" and the years of civil war in which no reliable record of battle deaths are available are excluded from the dataset. We cannot simply give a zero value when deaths had almost certainly occurred, nor can we give an average amount of battle deaths if the actual number may be much more or much less. Therefore, we simply exclude these combatant deaths from the sample.

The Correlates of War codebook[35] describes these occasions as "data unknown" or "not applicable" which means the total amount of battle deaths are unknown or there were no battle deaths for one side. The Intra-state war database records wars that take place "within the recognized territory of a state" and "the war must involve sustained combat, involving organized armed forces, resulting in a minimum of 1,000 battle-related combatant fatalities within a twelve month period" (http://cow.dss.ucdavis.edu/data-sets/COW-war/intra-state-war-data-codebook).

3.4 Predictors of civil war's severity

3.4.1 Civil war's duration

Civil war's duration (see Table 1) is measured as the cumulative number of years in which a country has experienced civil war. Civil war duration measured in Lacina

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[34] See Table 37 on p. 105 with the civil war severity variable defined as average battle deaths.

[35] The intra-state wars codebook can be found at: http://cow.dss.ucdavis.edu/data-sets/COW-war/intra-state-war-data-codebook.

(2006) is simply the length of a civil war – an appropriate specification for ordinary least squares, but data organized in a panel time-series fashion should measure duration differently. For instance, in Collier et al. (2004), duration is measured as a dummy variable in monthly survival analysis. The goal of my estimation is to find the effect of increasing number of years engaged in civil war and my specification in Table 1 aims to find this effect.

Fearon (2004) explains civil war duration using a game theoretic model of credible commitments that suggest that settlement is more likely when the government's army is strong." Therefore, I test military strength as an instrument to control for endogeneity in civil war's duration and severity. However, Fearon (2004) explains that there is no agreed upon set up determinants for civil war's duration, but democracy and military strength seem to be related to duration.

3.4.2 Regime durability

The duration of peace between civil wars has been an explanatory variable in previous conflict models[36] and regime durability measures the number of years since a change in regime (government). The change in government is indicated by a 0 and every year that follows receives a value of 1 until the next regime change. The regime change is determined by the polity scale in a year for which the country becomes substantially more democratic or autocratic (+/- 3 points).

[36] Collier and Hoeffler (2004)

3.4.3 Fuel exports (percent of merchandise exports)

Countries that have more exports comprised of oil, diamonds, and other natural resources are at higher risk for civil war since the acquisition of such goods can be financially lucrative. A government can also extract high rents from the production and exportation of oil thus increasing the benefit of civil war for government control. Collier (2004) explains that grievances play a role in recruitment of rebels, but sometimes the underlying reasons for civil unrest are economic.

Fearon (2005) argues that the inclusion of primary commodity exports in Collier (2004) may capture a real driver of conflict which is oil exportation. The oil exportation variable presented in this paper is fuel exports as a percentage of merchandise exports from the World Development Indicators 2013 database[37]. It is positively correlated with the onset of civil war. When fuel exports comprise a large percentage of exports, the probability of conflict is higher.

3.4.4 Hyperinflation

Steve Hanke and Nicholas Krus are economists at the Johns Hopkins University and they've collected 56 instances of hyperinflation dating back to the French Revolution in 1795. The exchange rate between two countries is key to identifying hyperinflation. Hanke explains, "the ratio of the price level between two countries is equivalent to their exchange rate". If one country experiences hyperinflation, then the

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[37] This variable is also similar to primary commodity exports used in Reynal-Querol (2002).

exchange rate with another country changes drastically. Two trading partners can therefore both eventually experience hyperinflation as rising prices “travel” through trade.

Most of the hyperinflation data is in terms of consumer prices since they “best reflect price changes experienced by the final consumer”. Hanke defines hyperinflation according to Cagan (1956) which is a monthly inflation rate greater than 50 percent.

Both civil and international war are also associated with hyperinflation. Hanke explains, “Hyperinflation is an economic malady that arises under extreme conditions: war, political mismanagement, and the transition from a command to market-based economy – to name a few.”[38] A regime change, for instance due to a successful rebel overthrow of government, can change the structure of government and therefore also the economy.

3.4.5 Systemic banking crises

In the midst of the 2008 financial crisis, two researchers from the International Monetary Fund prepared a database on systemic banking crises with a focus on the timing and type of crisis. The financial crisis variable comes from Valencia and Laeven (2008) and identifies the start and end of 42 banking crises.

I’ve identified these banking crises with a dummy variable taking the value of 1 at the onset of crisis and every year during the crisis. The years for which no banking crisis

[38] http://object.cato.org/sites/cato.org/files/pubs/pdf/workingpaper-8.pdf

occurred receive a value of 0. This variable identifies the onset and duration of financial crises associated with banking.

The timing of a banking crisis is determined by the amount of non-performing loans as a percentage of total loans, gross fiscal costs and output loss as a percentage of GDP, and minimum real GDP growth. The researchers cross-check the crisis dates with the timing of deposit runs, deposit freezes, liquidity support, and bank interventions (Valencia and Laeven, 2008). This variable is positively correlated with civil war.

Demand deposits and capital formation as a percentage of GDP, along with real GDP growth are also described below as they are significant predictors of the onset of civil war in addition to financial crisis. Many conditions requisite for financial crisis are also shared by civil war due to the relative decrease in opportunity costs of rebellion and relative increase in benefits through stolen commodities, rents on those commodities, or government control and appropriation of wealth.

3.4.6 Military quality

A measure of state capacity to engage in counterinsurgency, military quality, is defined as military expenditure divided by the number of armed personnel. Both military expenditure and armed personnel variables come from the World Development Indicators 2013 dataset. A less severe war will involve a highly-trained military with multiple resources at its disposal to suppress a rebel threat with minimal violence. This variable is expected to be negatively correlated with the number of battle deaths, a measure of war severity.

3.4.7 Religious Fractionalization

There is some theory and less empirical evidence that religious divisions among a society will cause rebellion and conflict (Elbadawi and Sambanis (2002); Ellingsen (2000); Reynal-Querol (2002). From Lacina's work on civil war severity, religious differences do not significantly predict more violent wars. However, there has been some evidence on the role of religion in economic growth (Barro and McCleary, 2003) and conflict (Reynal-Querol, 2002) and the model in Lacina (2006) can be improved upon with the addition of certain variables.

The measure of religious fractionalization is similar to ethnic fractionalization – the scale from 0 to 1 reflects the probability of selecting two random people from the same religious group in a population. Empirical studies of conflict suggest that greater religious diversity equates to less conflict. This variable typically has a positive relationship to civil war.

3.4.8 Political Terror – U.S. State Department

This measure of terror from Teorell, Dahlberg, Holmberg, Rothstein, Hartmann and Svensson (2015) does not take into account personal actors pursuing their own ideological agenda apart from the state, i.e. Islamic terrorism in the West, but measures political repression by a government. An example is a government leader murdering a political opponent or detaining a political dissident indefinitely.

The political terror index measures the power government has to oppress or eliminate its citizens. A government which is not bound by human rights laws can more

easily kill civilians and rebels that cause political trouble. The index is scaled from 1 to 5 indicating the following:

5: Terror has expanded to the whole population. The leaders of these societies place no limits on the means or thoroughness with which they pursue personal or ideological goals.

4: Civil and political rights violations have expanded to large numbers of the population. Murders, disappearances, and torture are a common part of life. In spite of its generality, on this level terror affects those who interest themselves in politics or ideas.

3: There is extensive political imprisonment, or a recent history of such imprisonment. Execution or other political murders and brutality may be common. Unlimited detention, with or without a trial, for political views is accepted.

2: There is a limited amount of imprisonment for nonviolent political activity. However, few persons are affected, torture and beatings are exceptional. Political murder is rare.

1: Countries under a secure rule of law, people are not imprisoned for their view, and torture is rare or exceptional. Political murders are extremely rare.

3.5 Building a model of civil war's severity

In considering a large sample of countries, a more detailed analysis of factors occurring before a civil war is possible. For instance, it has been suggested that recessions can spur a rebellion by lowering the opportunity costs associated with joining war (Blomberg 2002). These economic recessions, and their wealth diminishing characteristics, occur before a civil war and may contribute to the severity of war. Thus a time-series regression can capture conditions before the onset of war which contribute to the severity of a civil war.

Each country also has its own specific starting level of GDP and population which suggests some usefulness in panel estimation. It's not clear why battle deaths, population, and GDP are logged in Lacina's estimations; however, the reason may be due to the inherent differences in levels of those variables within each country. A panel estimation can account for this variation and allow the use of actual levels of battle deaths, population and GDP. This estimation is useful in determining the contribution of each variable to civil war's severity - it is simply easier to understand practically the coefficients of non-logged variables.

One of the highly significant predictors of civil war severity in Lacina (2006) is the duration of conflict. The reason for this, presumably, is that longer civil wars result in more battle-related deaths. However, it can also easily be argued that more battle-related deaths result in longer civil wars. Deaths due to a civil war can fuel grievances as rebel leaders are martyred or potential rebels witness the deaths of family and friends and join the rebellion. Therefore, endogeneity may be a problem in the ordinary

least squares regressions in Lacina (2006). To account for such endogeneity, I estimate using instrumental variables in a generalized method of moment (IV/GMM) regression framework.

IV/GMM estimation allows the researcher to control for the endogeneity of one independent variable by instrumenting with another variable which shares a strong positive or negative relationship. This instrument should also have very little relationship with the dependent variable. (What is my instrument and for which variable?) Therefore, the model I propose is a panel time-series estimation using IV/GMM.

Some contention may arise using these methods with a data set that includes times of peace, i.e. no battle deaths. Since the dependent variable contains not only battle deaths, but zero battle deaths, we're also measuring the onset of civil war. Therefore, it makes sense that some of the variables which predict the onset of war will also predict the severity of war simply due to the setup of this model.

3.6 Estimating civil war's severity

The original regressions of conflict variables with log battle deaths from Lacina (2006) in Table 1 Models 1 and 4 reveal that longer wars, wars after 1990, wars in non-democratic nations, and wars in ethnically homogeneous countries are more severe. From Chapter 2, financial crises and hyperinflation increase the risk of civil war for reasons of economic opportunity; however, perhaps such wars are also more severe for similar economic reasons.

Therefore, I include dummy variables of financial crisis and hyperinflation when such events occur concurrently with the civil war or within five years previous of war's

onset. The previous paper explained that the effects financial crises and hyperinflation may not be felt immediately, but compound over time. Thus wars associated with these economic events may be more severe and even last longer.

The hyperinflation variable enters into the OLS regressions significantly in Table 1 Models 2 and 5 and predict more severe wars. Financial crises do not significantly explain the severity of civil wars, but this may be due to the time span of the dataset from 1946 to 2002. Financial crises became more prevalent in the 1990s and 2000s and the dataset of financial crises only goes back to 1970. Therefore, several years of civil war which may be associated with financial crises are not included in the estimation.

Therefore, to more fully capture the annual effects of economic events, I estimate a panel time-series model of battle deaths using generalized method of moments with instrumental variables in Table 2. In Table 2 Model 1, variables commonly used to measure civil war's onset, along with variables proposed by Lacina (2006) like military quality and civil war's duration are estimated. The base model from which we add new economic variables is Model 2 in Table 2. Population does in fact matter, along with the number of years a government has sustained peace, GDP growth in the country, civil war's duration, and political terror committed by the state.

3.7 Conclusion

By estimating the severity of civil war in a country-year framework, we can determine short-run effects of unemployment, financial crisis, hyperinflation, and foreign aid during a civil war. Unemployment increases the severity of civil war as rebels are recruited from the pool of unemployed workers. Foreign aid has a negative effect on the

severity of war and explains the economic impact of outside help. A financial crisis results in relatively fewer battle deaths and hyperinflation has a significant, positive effect on battle deaths in civil war - roughly 387 more deaths with hyperinflation than without on average.

Table 37: Civil war severity

Country	Civil War	1950	1951	1952	1953	1954	1955
Philippines	Hukbalahap Rebellion (11,300 deaths total)	2260	2260	2260	2260	2260	0

Note: This is measured as average annual battle deaths in a country.

Table 38: OLS regressions of battle deaths in civil conflicts 1946-2002

	(1)	(2)	(3)	(4)	(5)	(6)
Ln duration	0.807***	0.833***	0.811***	0.857***	0.874***	0.847***
	(6.78)	(7.01)	(6.18)	(7.75)	(8.01)	(7.08)
Ln pop	-0.0444	-0.0415	-0.0442			
	(-0.55)	(-0.52)	(-0.54)			
ln milqual	0.101	0.0786	0.100			
	(0.84)	(0.66)	(0.83)			
Ln GDP	-0.191	-0.172	-0.189			
	(-1.09)	(-0.99)	(-1.05)			
Beginning year of conflict before 1989	0.667**	0.761**	0.656*	0.591**	0.715***	0.622**
	(2.13)	(2.42)	(1.86)	(2.20)	(2.64)	(2.05)
ln mountain	0.101	0.0557	0.101			
	(0.85)	(0.46)	(0.84)			
Democratic	-0.871**	-0.847**	-0.871**	-0.912***	-0.889***	-0.914***
	(-2.43)	(-2.39)	(-2.42)	(-2.79)	(-2.77)	(-2.79)
Ethnic polarization	-0.980***	-0.866**	-0.983***	-1.028***	-0.922***	-1.022***
	(-2.89)	(-2.54)	(-2.87)	(-3.39)	(-3.04)	(-3.34)
Religious polarization	0.119	0.0518	0.121			
	(0.37)	(0.16)	(0.37)			
Hyperinflation		0.643*			0.701**	
		(1.73)			(2.14)	
Financial Crisis			-0.0216			0.0708
			(-0.06)			(0.23)
Constant	9.543***	9.394***	9.537***	8.596***	8.277***	8.565***
	(4.83)	(4.80)	(4.80)	(24.76)	(22.20)	(22.84)
Observations	105	105	105	114	114	114
R^2	0.449	0.466	0.449	0.447	0.469	0.447

t statistics in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 39: IV/GMM regressions of battle deaths in civil conflicts

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
GDPgrowth2	-5.005***	-3.932**	-6.306***	-8.241***	-3.873	-6.072***	-8.394***	-6.182***
	(-3.12)	(-2.51)	(-3.64)	(-5.72)	(-1.03)	(-4.59)	(-5.79)	(-4.19)
p_durable	-2.247**	-2.852**	-2.414	-1.528	-9.279**	-2.349**	-1.524	-1.213
	(-2.10)	(-2.10)	(-1.60)	(-1.63)	(-2.39)	(-2.43)	(-1.62)	(-1.30)
Poplog2	-430.8***	-0.694	-83.54	-341.3***	-177.2	-217.3***	-345.9***	-345.0***
	(-7.29)	(-0.01)	(-0.89)	(-5.28)	(-0.75)	(-3.23)	(-5.33)	(-5.36)
civilwardur_good	155.0***	110.1***						
	(26.95)	(21.41)						
gd_ptss	113.7***	81.63***	110.5***	176.2***	141.8***	150.5***	176.8***	174.7***
	(8.12)	(6.27)	(7.71)	(13.93)	(6.53)	(12.66)	(13.97)	(13.88)
MilitaryQuality_2		15.49**	0.982					
		(2.49)	(0.14)					
GDPcaplog2		-5.110	11.80	173.3***	86.82	139.1***	169.7***	177.5***
		(-0.09)	(0.20)	(4.14)	(0.69)	(3.56)	(4.04)	(4.26)
Cold		-58.65	-75.48*	-72.61***	113.1***	-59.79**	-69.85***	-73.52***
		(-1.58)	(-1.84)	(-2.71)	(3.30)	(-1.99)	(-2.59)	(-2.75)
p_polity		-0.186	-0.957					
		(-0.27)	(-1.25)					
wdi_lue					4.735***			
					(3.78)			
wdi_aid_millions						-0.0401***		
						(-3.05)		
FinDummy							-32.06	
							(-1.00)	
HyperInf_all								465.7***
								(5.93)
Observations	2821	2167	2167	3885	713	3180	3885	3885
R^2	0.268	0.220	0.043	0.067	0.095	0.065	0.068	0.076

t statistics in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 40: IV/GMM regressions of battle deaths in civil conflicts

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
civilwardur_good	149.2***	155.0***	116.9***	148.8***	147.7***	108.9***	149.2***
	(30.77)	(26.95)	(19.46)	(30.40)	(29.07)	(21.42)	(30.77)
Poplog2	-329.8***	-430.8***	76.50	-337.8***	-331.2***	-52.97	-329.8***
	(-8.14)	(-7.29)	(1.14)	(-8.18)	(-8.09)	(-0.71)	(-8.14)
GDPgrowth2	-5.105***	-5.005***	-6.913***	-5.646***	-5.296***	-4.181***	-5.105***
	(-4.01)	(-3.12)	(-4.73)	(-4.21)	(-4.08)	(-2.81)	(-4.01)
p_durable	-1.303*	-2.247**	-2.713***	-1.322*	-1.262*	-3.003**	-1.303*
	(-1.75)	(-2.10)	(-2.62)	(-1.75)	(-1.67)	(-2.43)	(-1.75)
gd_ptss	100.6***	113.7***	90.76***	103.3***	103.1***	81.55***	100.6***
	(8.82)	(8.12)	(7.07)	(8.87)	(8.86)	(6.36)	(8.82)
Observations	3953	2821	1368	3875	3885	2195	3953
R^2	0.247	0.268	0.311	0.248	0.236	0.216	0.247

t statistics in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 41: IV/GMM regressions of battle deaths in civil conflicts - alternative model without economic variables

	(1) CW_deaths_avg_without	(2) CW_deaths_avg_without	(3) CW_deaths_avg_without
civilwardur_good	110.1***	110.2***	98.00***
	(21.41)	(21.63)	(10.26)
Poplog2	-0.694		
	(-0.01)		
MilitaryQuality_2	15.49**	15.34**	8.658
	(2.49)	(2.49)	(0.66)
GDPcaplog2	-5.110		
	(-0.09)		
Cold	-58.65	-58.73*	24.26
	(-1.58)	(-1.70)	(0.44)
p_polity	-0.186		
	(-0.27)		
GDPgrowth2	-3.932**	-3.949***	-3.694*
	(-2.51)	(-2.66)	(-1.78)
p_durable	-2.852**	-2.892**	-5.502**
	(-2.10)	(-2.39)	(-2.52)
gd_ptss	81.63***	81.12***	92.97***
	(6.27)	(6.34)	(4.74)
Observations	2167	2195	900
R^2	0.220	0.220	0.157

t statistics in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 42: IV/GMM regressions of battle deaths in civil conflicts - instrumenting war duration

	(1)	(2)	(3)	(4)	(5)
civilwardur_good	116.9***	117.2***	798.5***	114.5***	117.1***
	(19.46)	(19.53)	(27.37)	(15.83)	(19.53)
Poplog2	76.50				
	(1.14)				
GDPgrowth2	-6.913***	-6.957***	0.802	-6.094***	-5.639***
	(-4.73)	(-4.76)	(0.33)	(-3.37)	(-3.55)
p_durable	-2.713***	-2.339**	-0.0696	-3.621**	-2.209**
	(-2.62)	(-2.38)	(-0.07)	(-2.05)	(-2.24)
gd_ptss	90.76***	93.63***	26.49*	100.6***	94.35***
	(7.07)	(7.43)	(1.68)	(6.36)	(7.50)
wdi_lue			0.791		
			(0.93)		
wdi_aid_millions				-0.0187	
				(-0.67)	
HyperInf_all					133.3**
					(2.10)
Observations	1368	1368	524	922	1368
R^2	0.311	0.310	0.640	0.319	0.313

t statistics in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

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