ELSEVIER
www.elsevier.com/locate/worlddev

World Development Vol. 40, No. 9, pp. 1713–1722, 2012

0305-750X/$ - see front matter

http://dx.doi.org/10.1016/j.worlddev.2012.04.031

Development Consequences of Armed Conflict

SCOTT GATES
Peace Research Institute Oslo (PRIO), Oslo, Norway
Norwegian University of Science & Technology, Trondheim, Norway

HÅVARD HEGRE, HÅVARD MOKLEIV NYGÅRD *
Peace Research Institute Oslo (PRIO), Oslo, Norway
University of Oslo, Oslo, Norway

and

HÅVARD STRAND *
Peace Research Institute Oslo (PRIO), Oslo, Norway

Summary. — This paper conducts the first analysis of the effect of armed conflict on progress in meeting the United Nation's Millennium Development Goals. We also examine the effect of conflict on economic growth. Conflict has clear detrimental effects on the reduction of poverty and hunger, on primary education, on the reduction of child mortality, and on access to potable water. A medium-sized conflict with 2500 battle deaths is estimated to increase undernourishment an additional 3.3%, reduce life expectancy by about 1 year, increases infant mortality by 10%, and deprives an additional 1.8% of the population from access to potable water.

Key words — consequences of war, development, conflict, Millennium Development Goals, growth

1. INTRODUCTION

War is a development issue. War kills, but the consequences extend far beyond these direct deaths. In addition to battlefield casualties, armed conflict often leads to forced migration, refugee flows, capital flight, and the destruction of societies' infrastructure. Social, political, and economic institutions are indelibly harmed. The consequences of war, and especially civil war, for development are profound. War creates a development gap between those countries that have experienced armed conflict and those that have not.

This paper conducts a statistical analysis of the developmental consequences of conflict. The effects of armed conflict are evaluated with respect to achievement of the United Nation's Millennium Development Goals (MDG) as well as on economic growth. The eight MDGs are: end poverty and hunger; achieve universal education; achieve gender equality; improve child health; improve maternal health; combat HIV/AIDS; achieve environmental sustainability; and build a global partnership for development. The MDGs represent the closest thing to a global consensus on developmental priorities, yet so far no extensive research has been done on the effect of conflict on these goals. The analysis presented below shows that civil war harms the achievement of most of these development goals.

Table 1 shows the number of people (in millions) affected by conflict, broken down by the MDG indicators. The developing countries of the world are categorized into four groups according to their conflict status over the 1991–2008 period: (1) countries with at least 1 year of armed conflicts causing at least 1000 battle deaths during that period ("Conflict countries"); (2) countries that have not had any conflict in the period after 1990, but had experienced conflict at some time in the preceding 10 years ("Post-conflict"); (3) India, China, and Russia as a separate category; (4) and countries that have not had any conflict in the 1981–2008 period ("Other countries").[1] The first line of Table 1 reports the total population in 2008 in each of the five categories. Just short of 1 billion, out of a total of 5.8 billion people in the developing world, live in conflict countries. The analysis below shows that among these 1 billion inhabitants, more than 20%, or 208 million people, are estimated to be undernourished.

Some of the indicators in Table 1 are presented unconventionally so as to emphasize the negative. For the MDG on education (MDG 2), for instance, we present the percentage of children that are *not enrolled* in primary education. We do the same for secondary school *non*attainment, births *non*attendance, and *lack* of access to potable water and sanitation facilities.

We calculate the number of children that are not enrolled in primary education by first computing the total population in each age group for each conflict category and multiply with the proportions affected (for a more detailed analysis, see Gates, Hegre, Nygård, & Strand 2010).[2] We estimate for instance that 38 million out of about 230 million children in conflict countries that should have been enrolled in a primary school are not. About 30% of the primary school aged children

* This article is based on a background paper written for the World Bank's 2011 *World Development Report*. We especially thank Gary Milante, Sarah Cliffe, Colin Scott, and Nadia Piffaretti at the World Bank. We also thank Tilman Brück, Olaf DeGroot, Jim Fearon, Anke Hoeffler, Andy Mack, and other participants at a World Bank Brownbag Seminar, the Households in Conflict Network Workshops (in Berlin and Lisbon), a Norwegian Ministry of Foreign Affairs workshop, the 2010 Tinbergen meetings in Amsterdam, and the 2011 meeting of the International Studies Association for their valuable comments. We thank the World Bank and the Norwegian Ministry of Foreign Affairs for financial support. Final revision accepted: September 27, 2011.

Table 1. *Millions of people affected by conflict*

Development indicator	Year	All countries	Conflict countries	Post-conflict countries	India/China/Russia	Other developing countries
Population	2008	5827.3	994	426.9	2664.3	1527.7
Countries	2008	146	19	17	3	85
Undernourishment	2005	909.2	207.8	98	373.8	173.9
Poverty	2003	1694.8	265.2	218.5	828.4	302.6
No primary education	2005	115.4	38	25.7	25.6	23.3
No secondary education	2008	97.3	21	11.1	32.2	27.3
Infant mortality	2008	4.8	1.1	0.9	1.6	0.9
No birth attendance	2003	1723.7	361.4	241.6	696.5	332.5
HIV positive	2007	56.2	7.1	10.7	6.5	29.4
Without water	2006	908.4	189.5	175.4	294.9	187.3
Without sanitation	2006	2594.6	393.9	265.2	1334.4	480.1

Variables used in the econometric estimation	Definition	Source
Population	Logged total population	United Nations (2007)
Undernourishment	% of population living on less than minimum recommended dietary energy consumption	World Development Indicators 2011 (WDI)
Poverty	% of population living on less than USD 1.25 (PPP adjusted) per day	WDI
Primary schooling	% of students completing primary school	WDI
Secondary schooling	Portion of population that have attained secondary education	Hegre *et al.* (in press)
Infant mortality	The number of infants dying before reaching 1 year of age out of 1000	Hegre *et al.* (in press)
Birth attendance	Percentage of births attended by skilled medical personnel	WDI
HIV positive	Percentage of the population in the 15–49 age group that are HIV positive	WDI
Access to potable water	Percentage of population with access to an improved water source such as household connection, public standpipe or borehole	WDI
Access to sanitation	Percentage of population with access to excreta disposal facilities	WDI
Life expectancy	Years a newborn would live if prevailing patterns of mortality at the time of its birth were to stay the same throughout its life	WDI
GDP per capita	Gross Domestic Product per capita, constant dollars	WDI

that are not enrolled in primary education live in conflict-affected countries. About 1.4 billion people live in conflict and post-conflict countries—just under 25% of the developing world. Table 1 shows that these countries account for 34% of the undernourished population, 29% of the poverty, 56% of the population without primary education, and 35% of the births given without the attending of health personnel.

In this paper, we seek to assess the independent effect of conflict on the MDGs to assess the gaps shown in Table 1 between countries that have experienced conflict and those that have not. This assessment is tricky. Conflicts and poor development outcome may have the same causes, such as preexisting history of poverty and poor governance. We control for this to assess the development consequences of armed conflict.

In Section 2, we discuss the causal mechanisms and review relevant empirical studies. In Section 3, we summarize our methodological choices and present our conflict data. Section 4 summarizes the results of our analysis. Section 5 concludes and discusses policy implications.

2. HOW CONFLICT AFFECTS DEVELOPMENT OUTCOMES

(a) *Is the gap caused by conflict?*

To what extent is the gap between conflict countries and other countries a result of the conflicts themselves, and not to factors that are associated with both a high risk of internal conflict as well as poor performance on poverty indicators? Several studies indicate a causal effect. Ghobarah, Huth, and Russett (2003) argue that civil wars have long-term effects on civilian suffering. Analyzing the World Health Organization's measure of Disability Adjusted Life Years (DALYs), they stipulate that 8.01 million DALYs were lost in the year 1999 from civil wars which occurred during the period 1991–97. In Ghobarah et al. (2004), they argue that the additional burden of death and disability caused by the lingering effects of civil wars is nearly double the immediate and direct effect of these wars. Civil wars, they argue, "directly affect all the major contributors to health: exposure to disease, medical care, public health interventions, and overall socio-economic conditions" (Ghobarah et al., 2004, p. 871).

To best understand the development gap caused by armed conflict, we need to assess the counter-factual. In an experimental sense a treated case is compared to a control. In a quasi-experimental setting, we can either compare similar countries through matching or to simulate the effects of conflict for a given country. Figure 1 compares two relatively similar countries over time—Burundi and Burkina Faso.[3] The two countries followed a similar growth trajectory up to 1990 (shown with solid and dashed lines). Conflicts are shown in the figure in the form of bars with heights proportional to the number of Battle-Related Deaths (BRD). Both countries had short, minor conflicts during this period with no visible effect on the economy. In the 1990s, however, the paths diverge.

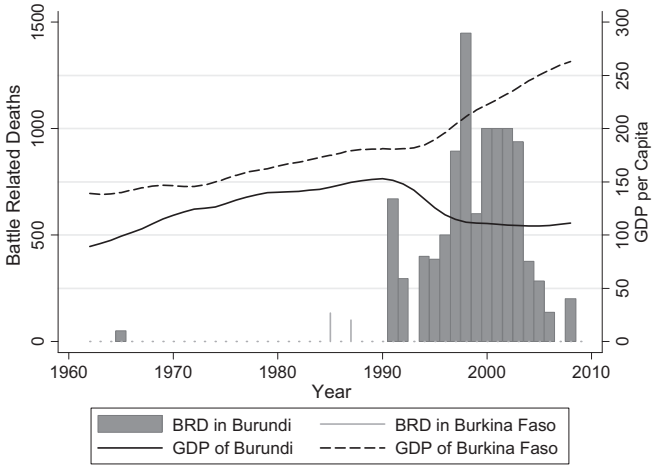

Figure 1. *Conflict and growth in Burundi and Burkina Faso.*

The civil war in Burundi swiftly destroys three decades of growth, while Burkina Faso takes part in the strong global growth of the post-Cold War area. By 2008, Burkina Faso's average income is more than twice the size of Burundi's.

(b) *Mechanisms*

Civil wars wreak havoc on economies. According to Collier (1999) this happens through five mechanisms: destruction of resources, disruption of social order, diversion of public expenditure, "dis-saving," and the shifting of assets out of the country. In *Breaking the Conflict Trap*, Collier *et al.* (2003, p. 17) consequently describe civil war as development in reverse—"after a typical civil war of 7 years duration, incomes would be around 15% lower than had the war not happened."

Ghobarah *et al.* (2003, pp. 191–192) develop a theoretical framework for analyzing the effect of conflict on the development outcomes summarized in the MDGs. They note that "health conditions are shaped by the interplay of exposure to conditions that create varying risks of death and disease for different groups in society and the ability of groups in society to gain access to health care and receive the full range of benefits produced by the health-care system." They list four sources of differences in health outcomes: (1) the extent to which populations are exposed to conditions that increase the risk of death, disease, and disability; (2) the financial and human resources available for addressing the public health needs of populations; (3) the level of resources actually allocated to public health needs by the private and public sectors; (4) the degree to which resources actually allocated to public health are efficiently utilized.

The first item mainly affects the health-related MDGs (MDG 1, 4, 5, and 6), whereas the three other items are equally relevant to the other outcomes we have analyzed. Civil wars directly expose populations to conditions that increase mortality and disability. The most obvious source is battle deaths. Fighting directly increases mortality and decreases life expectancy, if battle casualties are high enough.

The indirect effects of conflict are likely to be much greater than the direct effects. Civil wars displace large populations, and their temporary accommodation often exposes them to new risk factors. As noted by Ghobarah *et al.* (2003, p. 192), "epidemic diseases—tuberculosis, measles, pneumonia, cholera, typhoid, paratyphoid, and dysentery—are likely to emerge from crowding, bad water, and poor sanitation in camps, while malnutrition and stress compromise people's immune systems."

Epidemiological research shows that disease, and especially diarrhea, has a greater effect on mortality rates than direct battle deaths. Degomme and Guha-Sapir (2010, p. 297) study Darfur and argue that "more than 80% of excess deaths were not a result of [the] violence." Such excess deaths are the result of an increased spread of disease, which in turn drive up infant mortality rates. The increased spread may be caused by the inability or unwillingness of states to provide health services for their population during war time, or to conditions in refugee camps that increases the transmission of disease.

Widespread violence and physical destruction disrupts transportation, cutting rural populations off from health and education facilities. Military expenditures invariably increase during war, reducing funds available to promote public health, education, poverty alleviation, *etc.* (Gleditsch, Bjerkholt, Cappelen, Smith, & Dunne, 1996; Knight, Loayza, & Villanueva, 1996). Local economies may be disrupted, partly because of disincentives to invest at all, partly due to capital flight (Collier, 1999). The net effect is to reduce public spending.

Finally, conflict reduces the efficiency of the public health resources that are allocated. "Wartime destruction and disruption of the transportation infrastructure (roads, bridges, railroad systems, communications, and electricity) weakens the ability to distribute clean water, food, medicine, and relief supplies, both to refugees and to others who stay in place" (Ghobarah *et al.*, 2003, p. 193). Medical personnel tend to leave conflict zones if they can, leaving the poorest and most immobile behind.

Two methodological issues affecting this analysis deserve discussion. Firstly, it is clear from Table 1 that conflict countries perform worse than the other countries for most of the MDG indicators. Conflict countries are larger than nonconflict countries on average, and conflicts are often partly local and rarely directly affect the entire population in large countries (Buhaug & Gates, 2002; Buhaug & Rød, 2006; Raleigh, Hegre, Karlsen, & Linke, 2010). Measuring the effect of conflict using country-level indicators will therefore in many cases underestimate the local effect of conflict, and overestimate the effect on the median citizen.

The second issue regards endogeneity. Underdevelopment facilitates both the occurrence of conflict and undernourishment. Most conflict studies confirm that development as measured by GDP per capita or energy consumption per capita is among the most robust predictors of civil war (Collier *et al.*, 2003; Fearon & Laitin, 2003; Hegre, Ellingsen, Gates, & Gleditsch, 2001; Hegre & Sambanis, 2006; Hibbs, 1973). It is thus necessary to account for these factors to avoid attributing development effects to factors that tend to cause conflicts in the first place.

(c) *Effects of conflict on poverty and hunger*

Several studies confirm the popular perception that conflicts exacerbate poverty and hunger. Messer and Cohen (2004, p. 3) argue that "conflict causes food insecurity" and that civil conflicts in Africa since the mid-1960s until 2000 cost the region more than "$120 billion worth of agricultural production." Country studies carried out in post-conflict countries also find a marked increase in poverty and hunger during war. For Angola, Guha-Sapir and Gomez (2006, p. 13) find that malnutrition rates were severely affected by conflict, but that "one year after the cease-fire, Angola had been able to leave behind the high rates of crude mortality and malnutrition that field surveys had recorded during conflict." For Mozambique, Brück

(2006, p. 33) finds a more lasting effect of conflict. In the northern part of the country in 1997, 5 years after the civil war ended, "39% of all children under 3 years of age [were] moderately or severely underweight." Mozambique had a prevalence of undernourishment among the population of 52% in 1997. In comparison, in Burkina Faso, which has a similar GDP per capita but has largely avoided conflict, undernourishment affected only 12% of the population. According to the World Bank Sub-Saharan Africa "alone remains seriously off-track to achieve the poverty reduction MDG" (World Bank, 2007, p. 17).

We are not aware of any cross-national studies of conflict's effect on undernourishment beyond those reported here, or any systematic cross-national studies of the relationship between conflict and the poverty headcount variables. Poverty and undernourishment, however, are to a large extent determined by economic development broadly defined and captured by the GDP measure (Collier & Dollar, 2002). In this regard a substantial literature on the effect of conflict on economic factors exists, dealing both directly with issues such as GDP growth, but also with the composition of a country's economy and on the effect on, for example, military expenditure. [4]

Collier (1999, p. 175) finds that during "civil war the annual [GDP] growth rate is reduced by 2.2%." These results are confirmed by the results we present below. Collier finds a difference between long and short wars. While short wars "cause continued post-war [GDP] decline, [...] sufficiently long wars give rise to a phase of rapid growth" (Collier, 1999, pp. 175–176)—a "Phoenix effect" (Organski & Kugler 1980). The continued decline in GDP after short wars Collier attributes to post-war environments being less capital-friendly than a country's pre-war capital environment. [5]

Chen *et al.* (2008, p. 71) find that the "average level of per capita GDP is significantly lower after the war than before it," and this they argue is "undoubtedly a direct reflection of the cost of war." They too find that after "the destruction from war, recovery is achieved through above average growth," but this growth follows the pattern of "an inverted U, with the strongest results achieved in the fourth or fifth year after the onset of peace" (Chen *et al.*, 2008, pp. 72–79).

The effects of civil wars also tend to spill over into neighboring countries (Buhaug & Gleditsch, 2008; Gleditsch & Ward, 2000; Salehyan & Gleditsch, 2006). The effect on neighbors manifest in two ways: increased risk of civil war and lower economic growth rates (Murdoch & Sandler, 2002, 2004).

(d) *Effects of conflict on education*

Lai and Thyne (2007, p. 282) find that during civil war a state "reduces its educational expenditures by 3.1–3.6% each year." Perhaps more significantly the authors find that this reduction in spending is not due to a "guns for butter" tradeoff but that civil wars disrupt a state's "general ability to provide social services like education to its citizenry" (Lai & Thyne, 2007, p. 284). They also find that conflict reduces education enrollment. This is perhaps more disturbing since such an effect is likely to linger on long after the conflict has ended.

(e) *Effects of conflict on child mortality*

Infant Mortality Rates (IMR) are defined as the probability of dying between birth and 1 year, expressed as the number of infant deaths per 1000 live births. The measure is often employed as a proxy for a state's general socio-economic development as an independent variable (Abouharb & Kimball, 2007) since the data coverage for infant mortality is good in every region of the world.

Davis and Kuritsky (2002), Ammons (1996), and Stewart, Humphreys, and Lea (1997) all find that conflict increases infant mortality. For Sub-Saharan Africa, Davis and Kuritsky (2002, p. 9) find that countries that experienced conflict had average infant mortality rates 10% higher than those without any conflict experience. Iqbal (2010) finds that infant mortality is increased by conflict. Her finding, however, is not very robust. She attributes this to "the possibility that during protracted conflicts, populations adjust to societal conditions and appropriately guard against infant mortality" Iqbal (2010, p. 88).

(f) *Effects of conflict on access to water and sanitation*

The literature on the effect of conflict on access to adequate water and sanitation facilities is at best scarce. The percentage of the population that lacks access to adequate water and sanitation facilities has declined in every region of the world, but the shortfall between the MDG target and what has actually been achieved is greatest in the region with the most conflict, Sub-Saharan Africa (World Bank, 2007). According to the same report, less than 20% of less developed countries are on track to reach the goal in access to water, and less than 35% the goal in access to sanitation. Similar findings are reported by the United Nations (2009, pp. 45–46).

3. METHODOLOGY

(a) *Data*

We combine two datasets for our analysis. Since most of the outcome indicators are measured in 5-year intervals, most analyses are based on a dataset containing one observation for each country for each 5-year period. For the growth models, however, we use a country-year design with one observation for each country for each year. As outcome variables we use the variables listed in Table 1.

We exclude the industrialized countries, and thereby avoid including low growth rich and stable countries. [6] In most of our analysis we link conflict to improvements in development indicators. Many of the indicators, however, have a natural maximum. Primary education enrollment cannot exceed 100%, for instance. Many industrialized countries have reached the maximum values for many indicators, and rarely have armed conflicts.

The conflict data come from the Uppsala Conflict Data Program (UCDP), the most comprehensive, accurate, and widely-used data source on global armed conflicts (Gleditsch, Wallensteen, Eriksson, Sollenberg, & Strand, 2002; Harbom & Wallensteen, 2009). UCDP defines an armed conflict as a contested incompatibility that concerns government and/or territory where the use of armed force between two parties, of which at least one is the government of a state, results in at least 25 battle-related deaths. A civil (or intrastate) conflict occurs between a government and a nongovernmental party.

Our conflict measure is "Battle-related deaths," which is measured as the log of the count of battle-related deaths due to fighting in the 5 years preceding the observation period (Lacina & Gleditsch, 2005). About 20% of the country-periods in our dataset have conflicts. The median conflict incurred 2500 battle deaths. The most destructive conflict periods (in Afghanistan and Cambodia) caused over 200,000 deaths each.

(b) *Model specification*

We use fixed-effects regression models. These models remove between-countries differences in the outcome variables and concentrate on the within-country effects. The counter-factual to a conflict country, then, is the same country without conflict. If conflicts increase undernourishment, we should observe an increase relative to the country's average levels in the indicator during the conflict or in the period following the conflict.

Fixed-effects models may over-protect against omitted-variable bias. In particular, countries that have had conflicts consistently over the entire period for which we have data will not contribute much to the estimated effect of conflict—conflict is then largely part of the "fixed effect" itself. Since these countries also are likely to be the most severely affected by conflict, the fixed-effects model may yield too conservative estimates. This is accentuated by the fact that we have data only for relatively short periods. Some countries may be poor when our data series start because of the conflicts they have had up to then. Our models will also ignore this effect.

Despite this potential drawback, we produce these conservative estimates, which are more likely not to find an effect of conflict on development. In fact, we do find very substantial detrimental effects of conflict, especially when we have long time series.

Most indicators have time trends that show global improvement in the MDG indicators. Given these strong trends, conflict countries may also improve the general situation in the country. We include dummy variables for each 5-year period in the fixed-effects models to account for this.

4. RESULTS

Table 1 leaves no doubt that conflict countries have less favorable scores for all MDG indicators.

(a) *Results from fixed-effects estimation*

Table 2 shows results from the fixed-effects analysis of five MDG indicators. To account for global changes in the average levels for the indicators, we include dummy variables for each 5-year period. We also control for the size of the country. In column 1, we estimate the effect of the log of battle deaths variable for the undernourishment outcome. The analysis indicates a strong, detrimental effect of conflict. The estimate of 0.414 implies that a conflict of median severity (2500 deaths over 5 years) increases the undernourished proportion of population by about 3.3 percentage points. [7] This corresponds to about 300,000 persons in the median-sized country with about 10 million inhabitants.

We have tested whether the effect of conflict is contingent on the size of the country.

In a large country, a conflict may be extremely detrimental to a particular subnational region experiencing warfare, but has little effect on the country as a whole. For undernourishment, the effect of conflict, however, is country-wide.

Figure 2 illustrates the estimated effect of conflict on undernourishment for a typical country estimated through simulation modeling. This country had a population of about 15 million in 1970, increasing to 35 million in 2005. The initial undernourishment proportion for the hypothetical country was about 20% in 1970. The dotted line in the figure represents the baseline scenario without any conflicts—the counterfac-

Table 2. *Fixed-effects regression analysis of poverty, undernourishment, and mortality outcome variables*

	Undernourishment	Poverty	Life expectancy	GDP per capita	Infant mortality
Battle-related deaths (ln)	0.416***	0.115	−0.125***	−0.0205***	0.0129***
	(0.106)	(0.193)	(0.0359)	(0.00370)	(0.00284)
Neighboring conflict	−0.126	0.203	0.0153	−0.00659	0.00568
	(0.108)	(0.180)	(0.0402)	(0.00408)	(0.00318)
1970–74					
1975–79	–	–	1.707***	0.165***	−0.204***
	–	–	(0.0393)	(0.0421)	(0.0315)
1980–84	–	0.754	3.175***	0.357***	−0.437***
	–	(4.141)	(0.413)	(0.0444)	(0.0328)
1985–89	–	–	4.455***	0.417***	−0.659***
	–	–	(0.460)	(0.0491)	(0.0366)
1990–94	–	−0.855	5.218***	0.548***	−0.845***
	–	(1.886)	(0.514)	(0.0554)	(0.0406)
1995–99	–	−2.507	5.746***	0.634***	−1.018***
	–	(2.007)	(0.568)	(0.0606)	(0.0448)
2000–04	−0.835	−3.248	5.983***	0.776***	−1.186***
	(0.581)	(2.337)	(0.618)	(0.0666)	(0.0488)
2005–09	−2.222**	−6.151*	6.655***	0.961***	−1.361***
	(0.841)	(2.715)	(0.657)	(0.0718)	(0.0519)
Population (ln)	−2.967	−9.292	5.298***	−0.655***	0.387***
	(3.758)	(5.623)	(0.729)	(0.0805)	(0.0578)
Constant	45.63	117.7*	10.33	12.45***	1.144*
	(33.45)	(53.41)	(6.144)	(0.673)	(0.488)
N	395	278	1029	903	1006
Log likelihood	−941.0	−828.0	−2431.3	20.30	191.4

Standard errors in parentheses.
* $p < 0.05$.
** $p < 0.01$.
*** $p < 0.001$.

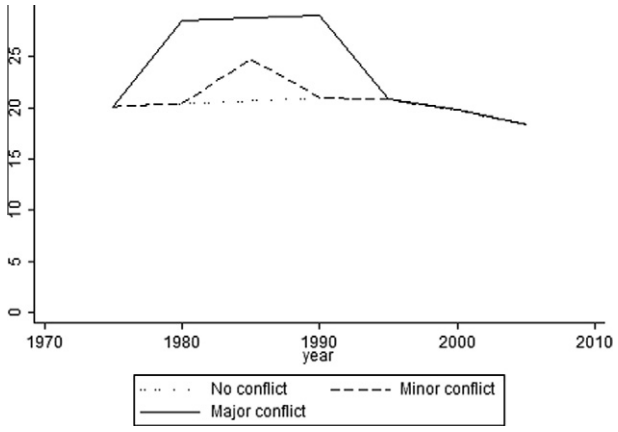

Figure 2. *Estimated effect of conflict on undernourishment.*

tual. The estimates from Table 2 imply that the poverty rate for the typical country is constant from 1970 to 1995, and thereafter slowly decreasing. [8]

The dashed line shows estimated poverty rates if this country had 5 years of minor conflict starting in 1980. The prevalence of undernourishment then increases to about 25% during those 5 years. The solid line shows estimated poverty rates if the country had 15 years of major conflict, starting in 1975. Undernourishment then increases to 28% for the entire 15-year period.

The result for the analysis of the relationship between conflict and poverty is presented in column 2 in Table 2. We find little trace of a direct effect of conflict on poverty. Estimates are largely in the expected direction, but not statistically significant. This is partly due to data sparseness—we have three consecutive observations for only just above 50 countries, and never more than 89 countries for a given year. Data also tend to be most sparse in conflict countries—we lack for instance data for Afghanistan, DRC, Algeria, and Sudan for the year 2000.

Column 3 shows that conflict variables also reduce life expectancy. The temporal dummies indicate that life expectancy has increased quite strongly over the 4 decades in question. The average person in a developing country can expect to live more than 6 years longer in 2008 than in 1970. Yet a conflict with 2500 battle-related deaths is enough to remove almost 1 year from each citizen of that country.

Column 4 shows that conflict also reduces GDP per capita. This relationship is discussed in more detail below. A median-size conflict is estimated to decrease GDP per capita with 15%.

Column 5 shows the effects with log infant mortality rates as the dependent variable. The analysis indicates that conflicts also have a clear detrimental effect on infant mortality rates. Again, we do not find the relative effect to be clearly contingent on the size of the country. The magnitude of the effect is large. 2500 battle deaths lead to a 10% increase in IMR. Both indicators, log of infant mortality rates and log of battle deaths, are in log form. In terms of elasticities, then, a 1% increase in battle deaths is associated with a 0.013% increase in infant mortality rates. This might not sound like a lot, but we must keep in mind that the latter figure refers to a rate. The current average mortality rate in developing countries is about 50 per 1000 born. In a median-sized country of about 10 million people and 200,000 infants, this corresponds to 10,000 infants per year. A 10% increase, then, is an excess mortality of 1000 infants per year. Over the 5-year period, a conflict with 2500 battle-related deaths seems to be associated with twice as many dead infants.

Table 3 shows results from the analysis of the education and environment outcome variables. The first column shows the effect of conflict on primary education. The estimates indicate that conflicts adversely affect education rates, but are not statistically significant. The second column shows the same model for male secondary school attainment rates, measured as the percentage of the relevant age group. Again, there is no discernible effect of conflict on education levels in the country—none of the estimates are statistically significant. Conflicts in the neighborhood seem to hurt secondary education, however. A country with a neighbor that had 5 years of minor conflict in the preceding period experiences an average reduction in education attainment of an additional 1.3%. [9] This roughly corresponds to losing 3–4 years of development relative to similar countries located in peaceful neighborhoods.

Columns 3 and 4 show the results for the environmental impact variables. The analyses indicate no clear relationship between conflict and access to sanitation, but there is a significant detrimental effect of conflict on access to potable water. The median conflict is estimated to cut off access to potable water for about 1.8% of the population. It is not unlikely that the increased infant mortality reported earlier is in part caused by lack of potable water.

(b) *Time to recovery from conflict*

Figure 2 indicates that countries immediately return to the pre-war level of undernourishment when the conflict is over. This is to some extent an artifact of our modeling. With data only for 5-year periods, we are not able to obtain statistically significant estimates for an adverse effect of conflict after the war. While these models represent a valid identification of the immediate consequence of conflict, predictions based on these results omit the case-specific history. Thus, after a given period, the post-conflict lag variables will no longer "remember" the case-specific conflict, and the predicted levels of economic development will be exactly equal to a similar case with no pre-occurring conflict.

For GDP per capita, we have annual observations and are better able to capture any delayed effects of conflict. To account for this, we estimate a population-averaged model with annual growth as dependent variable. The models incorporate an AR1 correction for the error terms within each country. This model also accounts for the fact that subsequent observations for the same country may be dependent on each other. The results are reported in Table 4.

We run a number of simulations based on these results to visualize the consequences of conflict. The dependent variable in these models is $X - X_{t-1}$, with X_{t-1} included as a control variable. By setting the initial level of for instance GDP/capita to $700 in 1969, we can use the estimated conflict dependent growth level to calculate the level of GDP/capita in 1970. The estimated level for 1970 can in turn be used to estimate 1971, and this routine can be iterated all the way up until today. By holding all other covariates fixed, we can then compare the estimated levels for different conflict scenarios.

Following King, Tomz, and Wittenberg (2000) we draw 1000 sets of coefficients from a multi-normal distribution based on the variance/covariance matrix produced by the regression model. Each of these draws is used to simulate the change from period to period for a scenario with conflict and a scenario without conflict. The result is 1000 different estimations of the corresponding level of interest at each period, and it is this set that is the basis of our figures.

Table 3. *Fixed-effects regression analysis of education and environment outcome variables*

	Primary schooling	Secondary schooling	Access to sanitation	Access to water
Battle-related deaths (ln)	−0.137	−0.000158	−0.0771	−0.245*
	(0.226)	(0.000744)	(0.0927)	(0.0951)
Neighboring conflict	0.215	−0.00266**	−0.0587	0.0920
	(0.217)	(0.000819)	(0.0977)	(0.0997)
1970–74 (ref.cat)	–	–	–	–
1975–79	–	0.0424***	–	–
	–	(0.00807)	–	–
1980–84	–	0.0809***	–	–
	–	(0.00843)	–	–
1985–89	–	0.123***	–	–
	–	(0.00931)	–	–
1990–94	–	0.152***	–	–
	–	(0.0103)	–	–
1995–99	–	0.176***	2.189***	1.944**
	–	(0.0113)	(0.617)	(0.636)
2000–04	−0.193	0.197***	4.339***	3.934***
	(1.212)	(0.0122)	(0.788)	(0.815)
2005–09	0.632	0.215***	6.124***	6.068***
	(1.773)	(0.0128)	(0.988)	(1.021)
Population (ln)	35.31***	0.0616***	3.088	5.760
	(7.797)	(0.0140)	(2.830)	(2.937)
Constant	−232.0***	0.142	28.62	22.36
	(67.97)	(0.119)	(25.10)	(25.96)
N	348	1035	485	500
Log likelihood	−1019.1	1562.0	−1269.8	−1330.7

Standard errors in parentheses.
*$p < 0.05$.
**$p < 0.01$.
***$p < 0.001$.

For GDP per capita, we estimate the extent to which the detrimental effects linger beyond the end of the war. Given the strong correlation between economic production and most of the MDG outcomes, this should give an indication of the extent to which the effect of conflict becomes permanent.

Figure 3 shows simulated GDP per capita levels for the 1970–2000 period for a country that started out at 1100 dollar per capita, about the level of Algeria in 1970. The dotted lines in the two sub-figures show the average growth trajectory for a nonconflict developing country. This is our simulated counterfactual. By means of regression models we have estimated the difference in growth rates from this average for countries that were at conflict at t, $t-1$, $t-2$, *etc.* The dashed lines indicate the growth trajectory for the same countries if they experience conflict. The left panel shows expected GDP per capita for a country with war (more than 1000 battle deaths per year) that broke out in 1974 and lasted for 5 years until 1978, with peace thereafter. The figure shows that the growth loss over the first 5 years of the conflict is very large—about 20% relative to the nonconflict country. The estimates indicate that countries see an immediate pick-up growth after conflicts of this duration. The right panel simulates a country that had an outbreak of war in 1974 that lasted for 13 years up to 1986. After 10 years of conflict, some conflict-countries tend to recover some of their war losses. This continues in the first 5 years of the post-conflict period. Five years after the conflict ended we can-

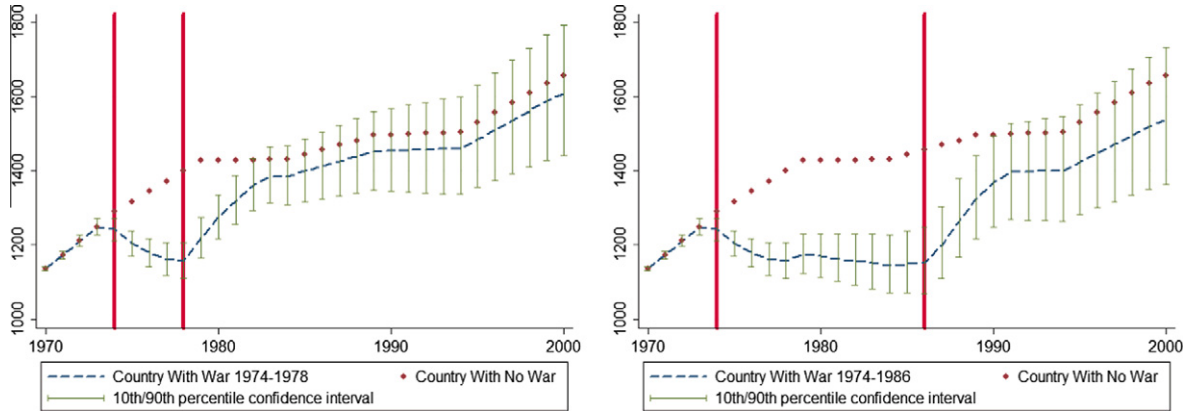

Figure 3. *Simulated change in GDP per capita 1970–2000, for conflict and nonconflict country, short war (1974–78) and long war (1974–86).*

Table 4. *Effect of conflict on annual growth in GDP per capita (PPP, logged)*

	(1) Growth
GDP per capita, $t-1$ (ln)	−0.00267*
	(0.00109)
Conflict	−0.0192***
	(0.00270)
Conflict, $t-1$	−0.00685*
	(0.00321)
Conflict, $t-2$	0.00502
	(0.00325)
Conflict, $t-3$	0.00191
	(0.00329)
Conflict, $t-4$	0.00691*
	(0.00325)
Conflict, $t-5$	0.00902***
	(0.00273)
1970–75	−0.0113***
	(0.00325)
1978–80	−0.0316***
	(0.00321)
1980–85	−0.0227***
	(0.00323)
1985–90	−0.0304***
	(0.00326)
1990–95	−0.0148***
	(0.00329)
1995–00	−0.0187***
	(0.00334)
2000–05	−0.00586
	(0.00356)
East Central Asia	0.0139
	(0.00969)
Latin American & Caribbean	−0.0197***
	(0.00344)
Middle East & North Africa	−0.0164***
	(0.00382)
OECD	−0.0155***
	(0.00413)
South Asia	−0.00861
	(0.00487)
Sub-Saharan Africa	−0.0229***
	(0.00363)
Ethnic fractionalization	−0.0161***
	(0.00367)
Secondary education rates	0.0215***
	(0.00571)
Population (ln)	0.00138*
	(0.000575)
Constant	0.0542***
	(0.0103)
Observations	4401
Log likelihood	6860.6

Standard errors in parentheses.
*$p < 0.05$.
**$p < 0.01$.
***$p < 0.001$.

not discern further pick-up growth in neither of the scenarios. The aggregate pick-up growth up to then is on average not sufficient to close the gap caused by the conflict. The median conflict country is almost 10% under the trajectory it would have followed without the conflict. There are some uncertainties in these estimates—the probability that the conflict country closes the gap to the nonconflict country is larger than 10%. But the probability that the aggregate growth loss is as large as 20% is also larger than 10%.

Table 5. *Summary of regression results, Millennium Development Goals*

MDG	Label	Indicator	Effect of conflict
MDG 1	Ending poverty and hunger	Undernourishment	Detrimental
		Poverty headcount	Detrimental
		Life expectancy	Detrimental
		GDP per capita	Detrimental
MDG 2	Universal education	Primary school enrollment	Unclear
		Secondary school attainment	Unclear
MDG 4	Child mortality	Infant mortality	Detrimental
MDG 5	Maternal mort.	Birth attendance	Unclear
MDG 7	Environmental sustainability	Access to water	Detrimental
		Access to sanitation	Unclear

5. DISCUSSION AND CONCLUSION

The costs of war are paid by civilians. Our findings underscore why it is important that the international community remains focused on conflict resolution and peacekeeping. While the direct consequences of conflict are bad, the indirect consequences are much worse. Conflict is "development in reverse" (Collier *et al.*, 2003). The first and most basic policy recommendation from this article is therefore that sustainable development must take the risk of war into account.

Table 5 lists the MDGs as well as the various indicators we analyze to gauge the *causal effect* of conflict on the attainment of these goals. As the table shows, we find clear detrimental effects of conflict on the reduction of poverty and hunger, on primary education, on the reduction of child mortality, and on access to water. As discussed above, these effects are quite strong. Five years of sustained conflict with only a moderate amount of direct fatalities on average push 3–4% of the population into undernourishment. The long-term effects of undernourishment are grim (Ivanovic *et al.*, 2000), which underscores the importance of early intervention. Conflicts generate a surplus infant mortality at the same level as direct deaths—for every soldier killed in battle, one infant dies that would otherwise have survived through the indirect effects of conflict.

We find some evidence of a catch-up effect, where post-conflict countries exhibit faster economic growth than normal to regain the average income level expected in the absence of conflict within a decade after the end of the conflict. While this is good news, one should keep in mind the overall economic performance will differ across sectors. A likely cause for this recovery is international assistance. If this is the case, we warn against assuming that post-conflict reconstruction is likely to be the case no matter what we do. More research is needed to understand the post-conflict economic recovery across sectors.

We find very limited evidence that conflict affects gender parity measured as the female-to-male life expectancy ratio. Internal conflicts seem to harm males and females in equal measures. We also find no effect of conflict on access to sanitation facilities. Yet, these findings should not be cited as evidence for the lack of such effects. We have deliberately used a conservative estimator, which we expect to moderate our results.

The *Human Security Report* 2009/2010 highlights the decreasing costs of conflict. The report emphasizes trends in continued improvement in such indicators as infant mortality rates and maternal mortality even in countries engulfed in conflict. Our analysis also shows these general trends with respect to the MDGs. Nevertheless, we find that conflict affects MDG achievement during conflict and after. We find a clear gap between countries in conflict and those not experiencing conflict. We also find that the effect of war lingers. More intensive fighting leads to much longer recovery times. While key economic indicators might paint a rosy picture, the consequences of conflict on development remain immediate and persistent. Armed conflicts are an important obstacle to fulfilling the Millennium Developmental Goals.

NOTES

1. For definitions and sources for the variables reported here and in Figure 1, see Section 3.

2. We base these estimates on data from United Nations (2007) that give countries' populations grouped in 5-year intervals, for example, 0–4 years, 5–9 years, *etc.* To calculate the population in primary school age, we add the 10–14 year population and 80% of the 5–9 year population. For secondary school enrollment, we use 60% of the 15–19 year population. For infant mortality, we use the population in the 0–4 year category divided by 5.

3. This pair of countries is found using a method called Coarsened Exact Matching (Blackwell, Iacus, King, & Giuseppe, 2009). We took the list of countries with major conflict and used this method to pair each country in the conflict category with the most similar without major conflict.

4. See Collier *et al.* (2003) and Chen, Loayza, and Reynal-Querol (2008) for reviews.

5. See Davies (2008) for a detailed study of post-conflict capital flight.

6. We exclude: Austria, Australia, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Japan, Luxembourg, The Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, United Kingdom, and the United States.

7. The logarithm of 2500 is 7.82, which multiplied by the parameter estimates 0.494 is 3.3%.

8. The specification of the model underlying Figure 1 does not allow for only a partial recovery as is evident for GDP per capita in Figure 2. For most of the indicators we use, we have data only for every 5-year period. This precludes estimating the same type of model as the one shown in Table 4.

9. We code a dummy variable that takes on the value of 1 for a given country-year if any of that country's neighboring countries are coded as having a civil conflict. A neighbor is defined as any country within 500 km of the country's border.

REFERENCES

Abouharb, M. R., & Kimball, A. L. (2007). A new dataset on infant mortality rates, 1816–2002. *Journal of Peace Research, 44*(6), 743–754.

Ammons, L. (1996). Consequences of war on African countries' social and economic development. *African Studies Review, 39*(1), 67–82.

Blackwell, M., Iacus, S., King, G., & Giuseppe, P. (2009). Cem: Coarsened exact matching in Stata. *The Stata Journal, 9*(4), 524–546.

Brück, T. (2006). War and reconstruction in Northern Mozambique. *Economics of Peace and Security Journal, 1*(1), 29–36.

Buhaug, H., & Gates, S. (2002). The geography of civil war. *Journal of Peace Research, 39*(4), 417–433.

Buhaug, H., & Gleditsch, K. S. (2008). Contagion or confusion? Why conflicts cluster in space. *International Studies Quarterly, 52*(2), 215–233.

Buhaug, H., & Rød, J. K. (2006). Local determinants of African civil wars, 1970–2001. *Political Geography, 25*(3), 315–335.

Chen, S., Loayza, V. N., & Reynal-Querol, M. (2008). The aftermath of civil war. *The World Bank Economic Review, 22*(1), 63–85.

Collier, P. (1999). On the economic consequences of civil war. *Oxford Economic Papers, 51*(1), 168–183.

Collier, P., & Dollar, D. (2002). *Globalization, growth, and poverty*. Oxford: Oxford University Press.

Collier, P., Elliot, L., Hegre, H., Hoeffler, A., Reynal-Querol, M., & Sambanis, N. (2003). *Breaking the conflict trap. Civil war and development policy*. Oxford: Oxford University Press.

Davies, V. A. B. (2008). Postwar capital flight and inflation. *Journal of Peace Research, 45*(4), 519–537.

Davis, D. R., & Kuritsky, J. N. (2002). Violent conflict and its impact on health indicators in Sub-Saharan Africa, 1980 to 1997. Paper presented to the annual meeting of the international studies association, New Orleans, LA, March.

Degomme, O., & Guha-Sapir, D. (2010). Patterns of mortality rates in Darfur conflict. *The Lancet, 375*(9711), 294–300.

Fearon, J. D., & Laitin, D. L. (2003). Ethnicity, insurgency, and civil war. *American Political Science Review, 97*(1), 75–90.

Gates, S., Hegre, H., Nygård, H. M., & Strand, H. (2010). Consequences of armed conflict. Background paper for the 2011 World Development Report. URL: http://wdr2011.worldbank.org/PRIO.

Ghobarah, H. A., Huth, P. K., & Russett, B. M. (2003). Civil wars kill and maim people—long after the shooting stops. *American Political Science Review, 97*(2), 189–202.

Ghobarah, H. A., Huth, P. K., & Russett, B. M. (2004). The post-war public health effects of civil conflict. *Social Science and Medicine, 59*(4), 869–884.

Gleditsch, N. P., Bjerkholt, O., Cappelen, A., Smith, R. P., & Dunne, J. P. (Eds.) (1996). *The peace dividend*. Amsterdam: Elsevier.

Gleditsch, N. P., Wallensteen, P., Eriksson, M., Sollenberg, M., & Strand, H. (2002). Armed conflict 1946–2001: A new dataset. *Journal of Peace Research, 39*(5), 615–637.

Gleditsch, K. S., & Ward, M. D. (2000). War and peace in space and time: The role of democratization. *International Studies Quarterly, 44*(1), 1–29.

Guha-Sapir, D., & Gomez, V. T. (2006). Angola: The human impact of war—A data review of field surveys between 1999–2005. Report of the Centre for Research on the Epidemiology of Disasters (CRED), Brussels.

Harbom, L., & Wallensteen, P. (2009). Armed conflicts, 1946–2008. *Journal of Peace Research, 46*(4), 577–587.

Hegre, H., Ellingsen, T., Gates, S., & Gleditsch, N. P. (2001). Toward a democratic civil peace? Democracy, political change, and civil war, 1816–1992. *American Political Science Review, 95*(1), 33–48.

Hegre, H., Karlsen, J., Nygård, H., M., Strand, H., & Urdal, H. (in press). Predicting armed conflict 2010–2050. *International Studies Quarterly*.

Hegre, H., & Sambanis, N. (2006). Sensitivity analysis of empirical results on civil war onset. *Journal of Conflict Resolution, 50*(4), 508–535.

Hibbs, D. A. (1973). *Mass political violence. A cross-national causal analysis*. New York, NY: Wiley.
Iqbal, Z. (2010). *War and the health of nations*. Stanford, CA: Stanford University Press.
Ivanovic, D. M., Leiva, B., Hernan, T., Inzunzaa, N., Almagià, A., Toro, D. T., *et al.* (2000). Long-term effects of severe undernutrition during the first year of life on brain development and learning in Chilean high-school graduates. *Nutrition, 16*(11), 1056–1063.
King, G., Tomz, M., & Wittenberg, J. (2000). Making the most of statistical analyses: Improving interpretation and presentation. *American Journal of Political Science, 44*(2), 347–361.
Knight, M., Loayza, N., & Villanueva, D. (1996). The peace dividend: Military spending cuts and economic growth. World Bank Policy Research Working Paper No. 1577. Available at SSRN: http://ssrn.com/abstract=615030.
Lacina, B., & Gleditsch, N. P. (2005). Monitoring trends in global combat: A new dataset of battle deaths. *European Journal of Population, 21*(2–3), 145–166.
Lai, B., & Thyne, C. (2007). The effect of civil war on education. *Journal of Peace Research, 44*(3), 277–292.
Messer, E. M., & Cohen, M. J. (2004). Breaking the links between conflict and hunger in Africa. URL: http://www.ifpri.org/sites/default/_les/publications/ib26.pdf.
Murdoch, J. C., & Sandler, T. (2002). Economic growth, civil wars and spatial spillovers. *Journal of Conflict Resolution, 46*(1), 91–110.
Murdoch, J. C., & Sandler, T. (2004). Civil wars and economic growth: Spatial dispersion. *American Journal of Political Science, 48*(1), 138–151.
Organski, A. F. K., & Kugler, J. (1980). *The war ledger*. Chicago, IL: University of Chicago Press.
Raleigh, C., Hegre, H., Karlsen, J., & Linke, A. (2010). Introducing ACLED: An armed conflict location and event dataset. *Journal of Peace Research, 47*(5), 651–660.
Salehyan, I., & Gleditsch, K. G. (2006). Refugees and the spread of civil war. *International Organization, 60*(2), 335–366.
Stewart, F., Humphreys, F. P., & Lea, N. (1997). Civil conflict in developing countries over the last quarter of a century: An empirical overview of economic and social consequences. *Oxford Development Studies, 25*(1), 11–41.
United Nations. (2007). *World population prospects. The 2006 revision*. Number 202. New York, NY: United Nations.
United Nations (2009). *The millennium development goals report*. New York, NY: United Nations.
World Bank (2007). *Global monitoring report 2007*. Washington, DC: The International Bank for Reconstruction and Development.