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Growing-up Unfortunate: War and Human Capital in Ethiopia

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Abstract

It is well-documented that early life outcomes can have lasting impacts during adulthood. This paper investigates two of the main channels - childhood health and schooling outcomes - through which the Eritrean-Ethiopian war may have negative intergenerational economic impacts. Using unique child level panel data from Ethiopia, identification of the effect is based on a difference-in-difference approach when both old and young children have the same average ages after controlling for observable household and child level time-variant characteristics. This adds to the existing empirical literature that use only cross-sectional data to compare cohorts of children born before and after the war in war-affected and non-affected regions, confounding the effect, potentially overestimating the impact. This is because old cohort children in war-affected region can accumulate larger deficits despite the war while young cohort could lookalike if war-affected region is, for instance, initially drought prone or poorer.

The results show that exposed children have about a third of a standard deviation lower height-for-age z-scores and childhood stunting by about 11 percentage points. In addition, exposed children are likely to complete fewer grades, less likely to be enrolled in school, and more likely to exhibit reading problems. These are disconcerting findings, as early life outcomes can have lasting impacts during adulthood. Future research that focusses on mechanisms by which war affects children may improve the design of appropriate policy on how to target and support children confronted with war.

Key Words: Childhood Human Capital; War; Ethiopia; Africa

1 Introduction

Many countries especially in Africa are exposed to both natural and human induced shocks. War is one such human-made shock that has reoccurred at an unfortunate frequency across Africa in recent history (Nduwimana, 2000).

Exposure to war or conflict can have severe implications (World Bank, 2011). Human capital can be affected by war, especially for children, through increased malnutrition and ill-health, and reduction of education. The young are usually vulnerable to adverse shocks such as war because their attachment to their parents could be disrupted (Santa Barbara, 2006). They are also at an early stage of growth and many human capital investments are age-specific (Justino, Leone and Salardi, 2013). For instance, loss of a parent can cause both emotional and physical harm, and increase vulnerability to future risk (e.g., see Beegle, Weerdt and Dercon, 2006).

Through its effect on child human capital war can have a lasting impact, which might perpetuate intergenerational poverty. There is substantial literature that concludes that ill-health, nutritional, and educational deficiency in early life can have lasting consequences during adulthood health, education, and labour market outcomes (Alderman, Hoddinott, and Kinsey, 2006; Currie, 2008; Currie and Vogl, 2012; Lucas, 1998, 1999; Martorell, 1999; Silventoinen, 2003; Duflo, 2001). Grantham-McGregor and his co-authors argue that disadvantaged children in developing countries who do not reach their developmental potential are less likely to be productive adults (Grantham-McGregor et al., 2007). Therefore, shocks such as war can induce multiple equilibria poverty traps as exposure to war may bring permanent damage affecting intergenerational welfare.

However, despite these potential effects of war on economic welfare and human capital, there is but a small yet recently growing body of literature. Akresh et al. (2011) looked at the effect of civil war and crop failure on child stunting using cross-sectional household data from Rwanda. They found that children (both boys and girls) exposed to conflict exhibited about one standard deviation lower height-for-age-z-scores. Similarly, Bundervoet et al. (2009) found 0.35 (0.047 for each additional month of conflict exposure) standard deviation lower height-for-age-z-scores for those exposed in civil war in rural Burundi. Akresh et al. (2012) looked at adults with and without exposure to the Nigerian civil war when these adults were children and adolescents. They found that adults exposed to (and survived) the war exhibited reduced stature (surprisingly the effect being larger for the exposure during adolescence than childhood) than unexposed adults 30 to 40 years later. A very close study by Akresh et al. (2012) use the 2002 Eritrean DHS cross-sectional survey data to investigate the impact of Ethiopian-Eritrean war on child height-for-age z-scores by exploiting exogenous variation in geographic extent and timing of conflict. They found that exposure to war decreases child height-for-age z-scores by about 0.45 standard deviations.

Studies that focus on child schooling outcomes also show negative impacts. These include studies conducted in countries such as Burundi for boys (Verwimp and Van Bavel, 2013) Peru for all children (Leon, 2012), Guatemala for both disadvantaged rural Mayan males and females (Chamarbagwala and Morn, 2011), Tajikistan for girls but not for boys (Shemyakina, 2011). However, the effect of conflict on education attainment of children seems to show mixed results. A recent study by Valente (2013) found that conflict intensity is associated with an increase of female (although the abductions by Maoists had negative effect) and male schooling attainment using data from Nepal. In addition, a study for Timor-Leste (Justino et al, 2013) using two waves of cross-sectional survey data found mixed short term and negative long term effect of exposure to conflict.

Most of these studies use cross-sectional data (that include cohorts born before and after war) and apply a difference-in-difference approach using time and spatial variation. The key implicit assumption of these studies is that in the absence of war (conflict), changes in outcomes between those children born after (young) and before (old) war (conflict) would have been the same for war (conflict) affected and non-affected areas. However, if poverty caused war (conflict) or war (conflict)-affected areas tend to be economically poor ex-ante, the key assumption may not hold as old cohorts may accumulate larger deficits than young cohorts, resulting potentially in an over-estimated impact of the conflict (Martorell and Habicht, 1986; Duflo, 2003).

This study looks at the effect of 1998-2000 Ethiopian-Eritrean war on child nutrition, health, and schooling outcomes in Ethiopia. Unlike the existing empirical literature, it exploits child panel data to compare outcomes for children born before (old cohort) and after the war (young cohort), in war-affected and non-affected areas when these two cohorts are at exactly the same average age, controlling for time variant characteristics. This would be impossible using cross-section data only because one needs panel data to track the young cohort up to the age of the old cohort. In addition, it is the first empirical evidence to identify the causal effect of Ethiopian-Eritrean war on a range of childhood human capital outcomes - height (stunting), grade completion, school enrolment, and reading ability - using this unique data set from the Young Lives survey with rich set of household and child level covariates to provide robust evidence.

Using a difference-in-difference approach, this study shows that children who were exposed to (and survived) the war between the age of 3-4 to 5-6 have, on average, about a third of a standard deviation lower height-for-age z-scores as compared to children that were not directly exposed to the war. The impact is larger and has stronger statistical significance for the rural sub-sample. In addition, war exposure increases childhood stunting by about 11 percentage points. Moreover, exposed children are more likely to complete fewer grades, less likely to be enrolled in school, and more likely to exhibit reading problems.

The rest of the paper is organised as follows. Section two describes the context by providing brief history of the war and potential mechanisms of its impact while section three presents the data and methods including detail outlines of the identification strategy and issues of potential bias. The fourth section presents results and discussion followed by the final section which concludes by inferring the predicted impact of the war on potential adult earnings.

2 The Eritrean-Ethiopian war

2.1 History

Eritrea was one of the regional states under the umbrella of Ethiopia and became an independent nation after a referendum in 1993 (Tronvoll, 1999). Five years later, a border conflict between Ethiopia and Eritrea led to a war lasting from May 1998 until June 2000 (Abbink, 1998).

According to a review by Gebru Tareke (2001), the Eritrean-Ethiopian war began as a territorial dispute on May 6, 1988, at Badme (a district in Tigray region), an insignificant village on the western side of the international border. Later on the war took place in two other locations Tsorona-Zalambessa and Bure of the Tigray and Afar regions respectively. Most of the battles took place in the Tigray region. Akresh et al. (2012) argue that both countries claimed sovereignty over these three areas of war due to the confusion over the border demarcation between the two countries.

The war led to significant loss of life and material damage for both nations. As documented in the report from Addis Ababa University (2012), both countries committed to large spending to mobilise military forces. It is estimated that the total cost of the conflict was about USD 280 and 397 million for Eritrea and Ethiopia, respectively, in addition to nearly 50 to 75 thousands of troops lost for each country (Addis Ababa University, 2012). Furthermore, a large number of people were internally displaced. As documented in the Internally Displaced Persons (IDP) global database of Norwegian Refugee Council, about 315,000 Ethiopians were displaced by December 1998 and this number grew to more than 360,000 on May 2000, of whom 90 percent were in the Tigray region and about 30,000 in the Afar region (Global IDP, 2004). The foregone GDP growth and the non-monetary human cost imply a significant impact on the overall economy of both nations.

However, due to geographic exposure, children who reside close to the war-affected region would be more affected than those in regions who are further from the battle field. In addition, after the war ended formally in June 2000, Ethiopia went through a more or less peaceful decade. This indicates children born after the war in both war-affected and non-affected regions are not directly exposed to the war. Therefore, causal effects can be identified by comparing changes in outcomes for children born before and after the war in war-affected and non-affected regions. This strategy relies on the assumption that the war is exogenous to child health and schooling outcomes in Ethiopia, given that the war was the result of border dispute between the two countries.

2.2 Mechanisms

The war can affect childhood human capital through a number of direct and indirect channels. Primarily, the war led to large internal displacement of people and loss of life. This can further cause loss of crops, livestock, productive inputs and assets, especially for rural farmers. These could all decrease the stock of food available to children (Akresh et al., 212).

In addition to displacement and loss of life, the war resulted in a direct form of destruction of health and education infrastructural facilities which are relevant environmental inputs to child growth, health and education outcomes (Lai and Thyne, 2007). For instance, it is documented that on 5 June 1998 theEritreanAir Force bombed Ayder School in Mek'ele (the capital city of the war affected region) killing twelve children. Most, if not all, of such destructions were happening in war-affected region comparing to the rest of the regions. Thus, such damage to physical infrastructure can significantly interrupt and decrease the process of child health and education accumulation.

Due to geographic proximity of the war affected region, children may hear the sounds from the battle field, overhear parents daily conversation about the war, or be confronted with the loss of life.

These could contribute to Post-war Trauma Stress Disorder (PTSD). Previous studies by Dyregrov et al. (2000), Papageorgiou et al. (2000), and Thabet and Vostanis (1999) found significant PTSD association with intrusion and avoidance for children exposed to the Rwandan genocide, and the Bosnian and Palestine wars. There is evidence that PTSD is a potential risk factor for mental health of children that may further affect their health and educational outcomes (eg. Currie and Stabile, 2006).

Finally, war could affect child poverty and human capital through its general equilibrium effects. For instance, the rate of private investment (or demand for investment) could decrease in war-affected regions in response to the war. In addition, return on investment could also decrease due to an immediate interruption of daily business, destruction of infrastructure, or instability caused by the war (Bruck, Naude and Verwimp, 2013, Collier and Duponchel, 2013), while agricultural output may diminish due to lack of supply or disrupted distribution of inputs.

3 Data and Methods

3.1 The Data Set and Summary Statistics

The data set comes from the Young Lives panel data of three rounds 2002, 2006 and 2009, collected by the Young Lives team of Oxford University in collaboration with the Ethiopian Development Research Institute and researchers from Addis Ababa University and Save the Children UK in Ethiopia (Alemu et al., 2003). Young Lives is a longitudinal childhood poverty study which tracks a sample of poor children in four developing countries Ethiopia, Peru, Vietnam, and India (Outes-Leon and Sanchez, 2008). As of 2002, the study has followed two cohorts in each of these four countries. The younger cohort consists of 2,000 children per country with an average age of 1 year in 2002. The older cohort consists of 1,000 children per country aged between 7.5 and 8.5 in 2002 (Alemu et al., 2003; Outes-Leon and Sanchez, 2008; Woldehanna, Mekonnen, and Alemu, 2008; Woldehanna, Gudisa, Tafere, and Pankhurst, 2011).

Table 1: Summary of the data: birth year and survey rounds

Pre-war period				War period			Post-war period/survey rounds			
								1	2	3
94	95	96	97	**98**	**99**	**2000**	2001	2002	2006	2009
							Young cohorts	1 yr	5 yrs	**8 yrs**
							Old cohorts	**8 yrs**	12 yrs	15 yrs

Source: Authors description

The sample in Ethiopia was selected based on a multi-stage sampling design. The first stage included a selection of 5 out of 9 regions (Tigray, Amhara, SNNP, Addis Ababa, and Oromia). These five regions cover about 96 percent of the total population of the country. Of these regions, 20 sites (about 3-5 districts per region) were selected based on pro-poor bias, balancing Ethiopian regional and ethnic differences and also the cost of sampling. Areas of food deficiency were over-sampled while sites in remote areas were underrepresented due to cost and logistic issues. In addition, at least one Peasant Association (PA) (in rural areas) or kebele (in urban areas) the lowest level of administrative structure in the country in each district was picked. Eventually, 100 children born between April 2001 and June 2002 (for the young cohort group) and 50 children born between April 1994 and June 1995 (for the old cohort group) were selected in each sentinel site using simple random sampling (Alemu et al., 2003; Outes-Leon and Sanchez, 2008; Woldehanna et al., 2008; Woldehanna et al., 2011)

The first outcome variable is standardized height-for-age z-score. It is calculated as the actual height of each child minus the median height of a WHO reference population of healthy children of same age and sex, divided by the standard deviation of this reference population. This implies that height-for-age z-score of zero for a given child would mean that the child is as well-nourished as the WHO reference group children, on average. The reason for selecting height-for-age rather than other anthropometric health indicators such as weight-for-age and body mass index, is that it is an indicator of long-term nutrition and health status (e.g., Deaton, 2007; Dercon, 2012; Hoddinott and Kinsey, 2001; Yamano, Alderman, and Christiaensen, 2005; Silventoinen, 2003; McCarron et al., 2002). The other outcomes include number of highest grade completed, whether a child is enrolled at school, and whether a child has reading problems.

Not all of these outcome variabless are observed in all three survey rounds of both cohorts. However, data on all of the outcome variables are available for the first round of the old and the third round of the young cohorts. These rounds reflect the age overlapping cohorts of 8 year olds in 2002 and 2009 (hereafter referred to as the restricted sample) together constitute 2,812 children used for the main analysis.

Panel A shows that the mean difference of child height (cm.), height-for-age z-score, and proportion of stunted children between war affected and non-affected regions is statistically significant for children born before the war (the old cohorts). However, these are not statistically different

Table 2: Summary statistics of outcome variables by cohort and region of war exposure

Panel A		**Old**			**Young**	
Region	**height**	**hfa**	**stunted**	**height**	**hfa**	**stunted**
Non-war exposed (1)	118.57	-1.41	0.30	120.70	-1.20	0.22
War exposed (2)	116.13	-1.73	0.40	120.54	-1.21	0.18
Difference (1-2)	2.44***	0.32**	-0.11**	0.16	0.01	0.04
Panel B	**grade**	**enrolled**	**reading**	**grade**	**enrolled**	**reading**
Non-war exposed (1)	0.50	0.67	0.75	0.54	0.73	0.73
War exposed (2)	0.36	0.60	0.95	1.08	0.94	0.74
Difference (1-2)	0.14**	0.07	-0.19***	-0.55***	-0.21***	-0.01

hfa is Height-for-age z-scores, stunted is % age with less than -2 of hfa

from zero between war affected and non-affected regions for children born after the war (the young cohorts). This could be one indication that in the absence of war, children of both war-affected and non-affected regions in Ethiopia exhibit similar growth on average.

Panel B shows that old cohorts of the war-affected region exhibit fewer grades completed (statistically significant), are less likely to be enrolled in school (but not statistically significant), and are more likely to exhibit reading problems (statistically significant) than old cohorts of the non-war-affected regions. However, the young cohorts of war-affected regions completed more grades and are more likely to be enrolled in school (statistically significant). Unlike child height outcomes, the educational outcomes indicate that children of war-affected regions are different from non-affected regions even in the absence of war (i.e., for the young cohorts).

3.2 Identification Strategy and Potential bias

Childrens exposure to the war varies across time and geographic location. First, the old cohort of sampled children were born 3 to 4 years (from April 1994 to June 1995) before the war started and they experienced the full two-year war period (from May 1998 to June 2000), while the young were born just after the war (from April 2001 to June 2002). Second, the war cannot affect all children of old cohorts equally since it was concentrated in the northern and north east part of the country: in Badme, Tsorona-Zalambessa and Bure of the Tigray and Afar regions. Since the Young Lives data set doesnt include a sample from the Afar region, the area of war incidence in this study is the Tigray region while the other regions in the sample are considered less war-intense. Figure 1 shows the approximate location of the sentinel sites of Young Lives with the small dots while the bold line indicates Tigray and the boundary of Ethiopia with Eritrea. The districts of the main battle fields are indicated by larger dots approximately in the map. The combination of time and spatial dimensions of war exposure implies that a child is considered to be exposed to the war if born before the war (i.e. belongs to the old cohort) and is from the Tigray region. Thus, changes in outcomes between old and young cohorts for the non-war affected regions effectively serve as control group to the changes in outcomes between old and young cohorts in the war-affected region.

Figure 1: Map of Ethiopia with data points

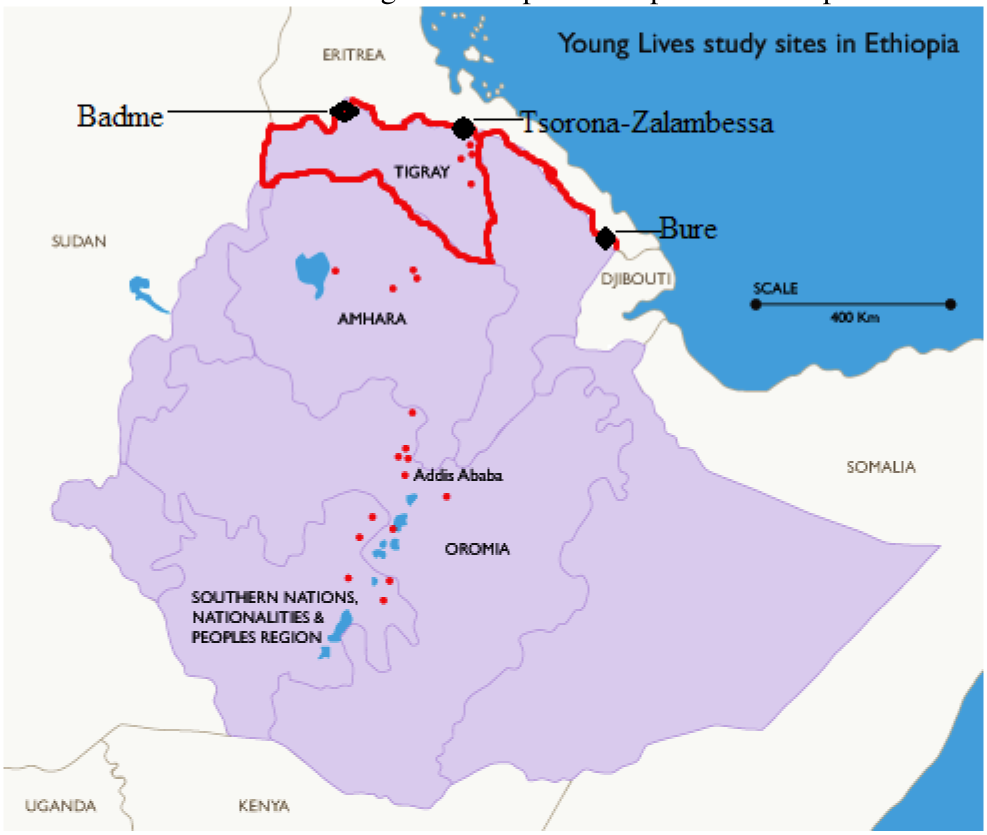
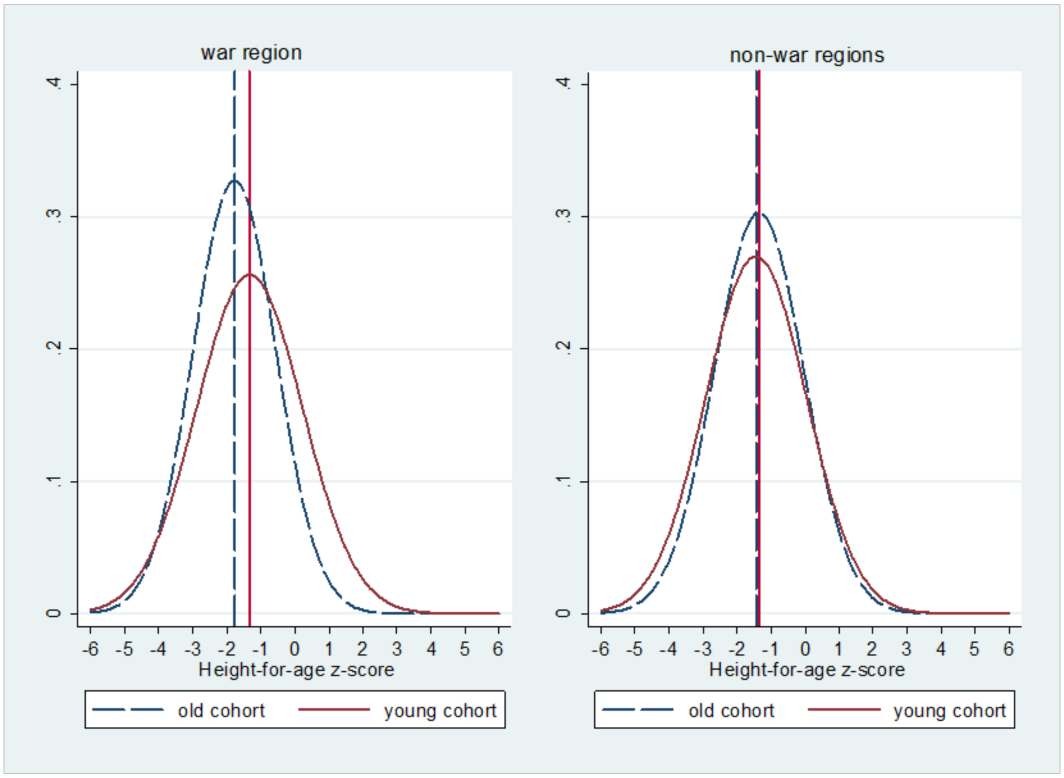


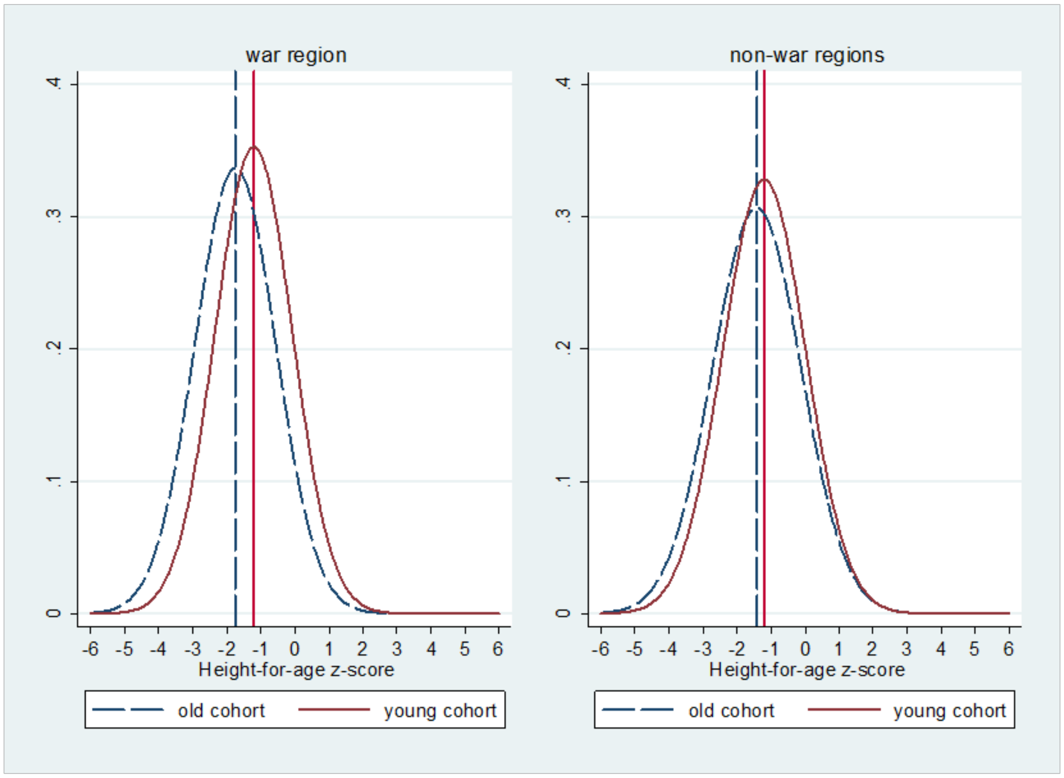
Figure 2 shows the distribution of the height-for-age z-score by cohort and region of war exposure using the panel data pooled for all children. First, it is clear that all cohorts in both regions have, on average, a negatively skewed distribution suggesting that the sampled children are on average of lower height relative to the WHO reference population of healthy children. However, there is a significant difference in the gap of the distribution in height-for-age z scores between old and young cohorts for war-affected and non-affected regions. In the war-affected region, old cohorts show a relatively higher incidence of stunting compared to the young cohorts, while both cohorts have nearly the same distribution in the non-war affected regions, on average.

Figure 2: Height-for-age z-score distribution by cohort and region of war exposure



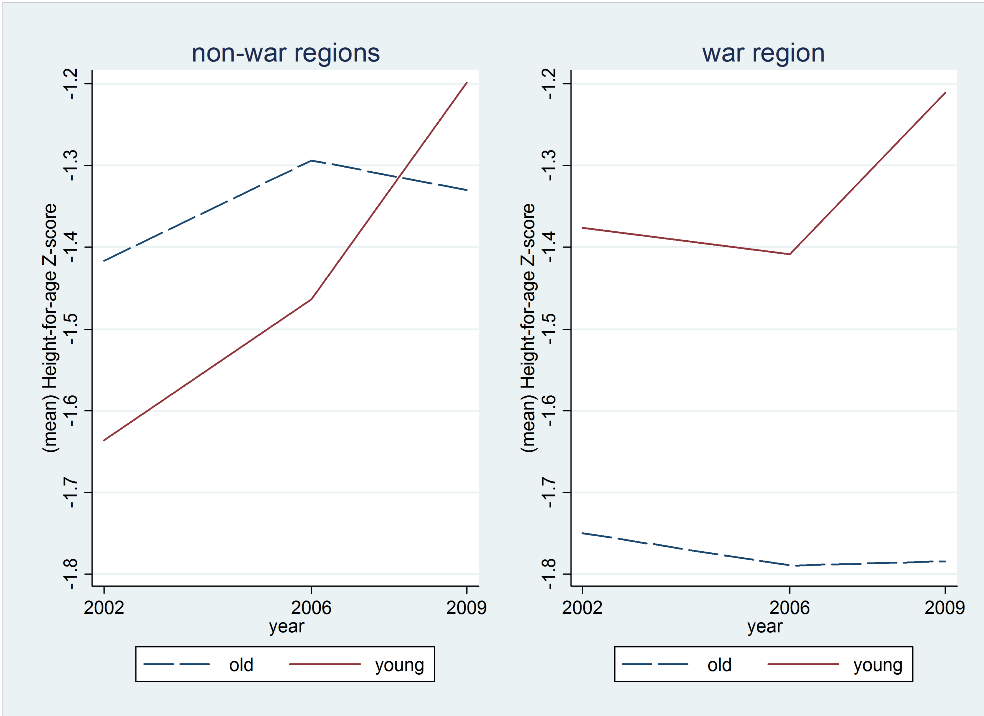
Even though the height-for-age z-score is calculated by adjusting for age and sex of the child, comparing children of same age is more convincing due to non-linearity of child growth. Figure 3 shows the distribution of young of the old (age 8 in 2002 survey round) and old of the young (age 8 in 2009 survey round) cohorts. It is again clear that the gap of the distribution in height-for-age z scores between young and old cohorts is larger in the war-affected region as compared to the non-war affected regions. If changes between young and old cohorts are only due to the cohort effect and not due to the war (conflict), then we should have seen similar differences for both the war-affected and non-affected regions, on average.

Figure 3: Height-for-age z-score distribution by cohort and region of war exposure, restricted sample



Furthermore, the data seems to suggest that difference in human capital accumulation for the older cohort persist into young adulthood. Figure 4 shows how mean height-for-age z-score of the young cohorts in the war- and non-war-affected regions have converged by the age of 8 despite initial differences. However, this difference in height-for-age is substantial and consistent for the older cohorts from the average age of 8 to 15.

Figure 4: Trends in mean height-for-age-z score by cohort and region of war exposure

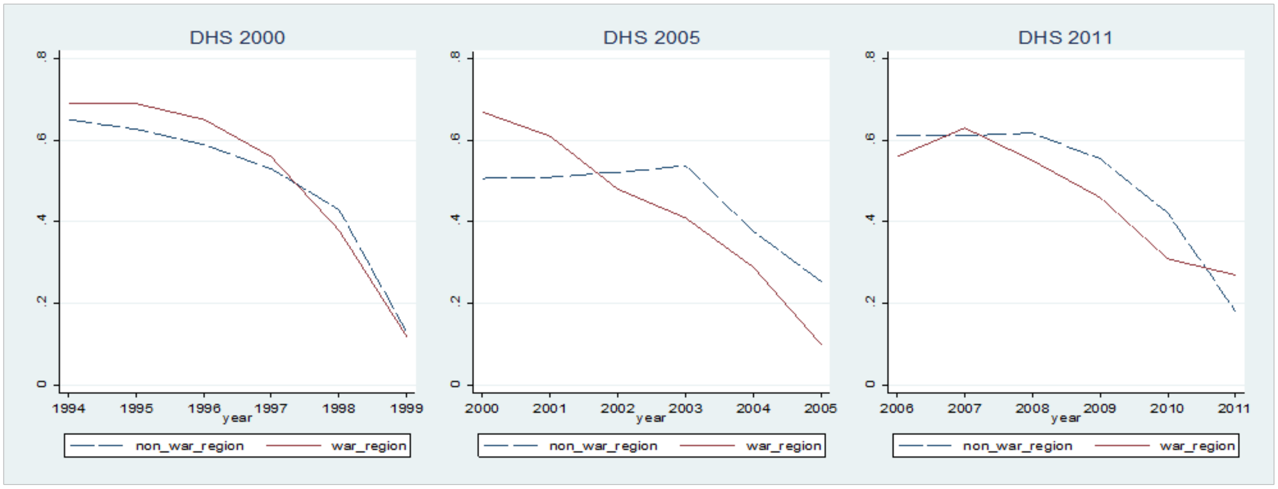


Using time and spatial variation, a given child will fall in either of four categories born before the war from war-affected regions ($\bar{y}_{w,o}$) and non-war-affected regions ($\bar{y}_{nw,o}$), or born after the war from war-affected regions ($\bar{y}_{w,y}$) and non-war-affected regions ($\bar{y}_{nw,y}$). Under the assumption that in the absence of war the regions would have followed similar trends in child health outcomes, the difference-in-difference estimate of the impact of war, $\hat{\theta}$, is unbiased and consistent.

$$\hat{\theta} = [\bar{y}_{w,o} - \bar{y}_{w,y}] - [\bar{y}_{nw,o} - \bar{y}_{nw,y}] \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

The primary threat to this strategy, which assumes parallel trends, is the presence of unobserved heterogeneity across regions that is time variant (Khandker, Koolwal, and Samad, 2010; Bertrand, Duflo and Mullainathan, 2004). For instance, unobservable investments in health and education in these regions could vary systematically for reasons other than the war. As an attempt for such potential threat of unobservable confounding trends, I assess vaccination trends for cohorts of children born between 1994 and 2011 in war-affected and non-affected regions using the three DHS survey rounds (2000, 2005 and 2011). Child vaccination is an important determinant of childhood growth and health (Ami, 1996; Agadjanian and Prata, 2003) reflecting policy decisions. The results presented in figure 5 show that there are no systematic differences in the percentage of children that received any vaccination across regions for cohorts born before and after the war period.

Figure 5: Trends in Vaccination rate of cohorts of children born from 1994 to 2011 using DHS survey by region of war exposure



Second, using height as measure of health outcome by itself is a threat to the identification strategy if war regions are initially poorer because the older children in relatively poor regions could be shorter than older children in the non-poor regions as the former could accumulate large poverty induced height deficit while the young cohorts may tend to be more similar (Martorell and Habicht, 1986; Duflo, 2003). This phenomenon leads for an upward bias of the impact estimate even if the parallel trend assumption is satisfied. To mitigate this, the main analysis will focus on the restricted sample (of same age children on average).

Third, another potential bias could come from either idiosyncratic or covariate shocks such as weather events that are not related to the war but may vary systematically between regions and cohorts. For this reason, the analysis controls for household reported shocks (at least for post war period) and village (community) level fixed effects. Usually, shocks such as drought and other natural disasters in Ethiopia are covariate shocks for households within a given village (or community) (Dercon, Hoddinott, and Woldehanna, 2005).

Fourth, due to the war, it is also more likely that people were displaced from their initial settlement. However, this is not a threat to the identification strategy for two reasons. First, most of such displacements took place within a region (Global IDP Project, 2004b). Second, the Young Lives team were able to track most sampled children with a low attrition rate of 3 percent throughout the three waves, which indicates a stable migration pattern.

Fifth, mothers exposed to the war may be affected by post-war trauma and stress. Mulder et al. (2002) conclude that maternal psychological factors may significantly contribute to pregnancy complications and unfavourable development of the (unborn) child. If such stress persists until mothers are pregnant of the young cohort children, this will potentially underestimate the true impact of war.

Sixth, an additional concern could be sample selection bias due to differences in mortality rates across regions over time because of the war. A child with better inherent health is more likely to survive than a child of similar characteristics with lower inherent health. This is because an inherently more healthy child needs a relatively smaller threshold stock of health to be able to survive a given shock or catastrophic event relative to an inherently less healthy child (Maccini and Yang, 2009). Such a selection bias will potentially lead to underestimates of the true impact.

Finally, measurement errors in child age, height, and education outcomes could be an issue. Parents may probably under report the age of a relatively shorter child (Akresh et al., 2011). However, the Young Lives data collection procedure asked for exact child date of birth which minimizes this error. Measuring height of one year old children for young cohorts may be difficult (Ulijaszek and Kerr, 1999) but the main analysis of this study considers outcomes of children with an average age of 8 years old.

Moulton (1986) argues that in a regression model where data are drawn from a population with grouped structure, the regression errors are often correlated within groups. These errors for children living in the same environment and that undergo similar events that potentially affect outcome variables, are more likely to be correlated. Consequently, assumptions of independent errors may not hold and unadjusted OLS standard errors may be biased downward. For this reason, standard errors are clustered at Woreda (or community) level to allow correlations across children within the Woreda (or community) and are robust to heteroscedasticity.

In general, while it is not possible to test the parallel trend assumption directly, the data set contains a rich set of information on child and household specific covariates which helps to control for several observables. These include child age and sex, parental literacy, age, sex, and education level of household head, wealth index, share of food expenditure, ownership of land, milk and livestock animals, household composition and size, and whether a household faced a drought shock.

The difference-in-difference model for estimating the impacts of the war for the restricted sample is specified as

$$Y = \alpha + \beta_1 * OldCohort_c + \sum_i \beta_i * Region_i + \theta * OldCohort_c * Warregion_W + \gamma * X + \mu + \upsilon .....(2)$$

Where Y is the outcome variable of interest, c is a cohort fixed effect, i is the set of region dummy variables, $Warregion_W$ takes value 1 if a child is from a war-affected region and 0 otherwise, X is a vector of child, parental, and household covariates, μ is a village (community) level fixed effect and υ is a random error term.

4 Regression results and discussion

4.1 Child health and nutrition

Tables 3 and 4 present results for impact of war on child height-for-age z-scores and child stuntedness. The first columns (in all regressions) only control for region and cohort fixed effects, providing the basic difference-in-difference results. The rest of columns, which controls for all possible covariates and fixed effects, show results are robust to various specifications.

Controlling for region and cohort fixed effects, the impact estimate (column 1 table 3) shows that a child exposed to the war has an average reduction of about a third of a standard deviation in the height-for-age z-score when looking at the full sample. This coefficient remains robust to choice of specification, both in magnitude and statistical significance. According to column 4, controlling for all possible confounding factors, the impact estimate is -0.37 standard deviation and is statistically significant at the 5 percent level. Looking at urban and rural sub-samples separately, the results are mainly driven by the rural sample, as none of the coefficients for the urban sample are statistically significant. This could be due to two reasons. First, the rural residents could be geographically closer to the war and hence more affected. Second, possibilities for recovery could be relatively better for urban dwellers than rural farmers. At least, health and education infrastructure would be more abundant and of better quality in urban areas. There is no clear difference between the female and male samples. The coefficients are of similar sign and magnitude as for the full sample, yet imprecise.

Table 3: The impact of war on child health and nutrition Dependent Variable: Height-for-age z-score

All Sample	1	2	3	4
born before war*war region	-0.31*	-0.30**	-0.39**	-0.37**
	[0.15]	[0.15]	[0.17]	[0.16]
N	2,812	2,812	2,170	2,141
Rural Sample				
born before war*war region	-0.43**	-0.44**	-0.43**	-0.43**
	[0.17]	[0.18]	[0.20]	[0.18]
N	1,730	1,730	1,439	1,423
Urban Sample				
born before war*war region	-0.11	0.03	-0.18	-0.11
	[0.21]	[0.19]	[0.13]	[0.14]
N	1,082	1,082	731	718
Girls Sample				
born before war*war region	-0.33	-0.26	-0.38	-0.30
	[0.19]	[0.18]	[0.23]	[0.22]
N	1,341	1,341	1,005	992
Boys Sample				
born before war*war region	-0.29	-0.31	-0.34	-0.38
	[0.26]	[0.26]	[0.23]	[0.24]
N	1,471	1,471	1,165	1,149
Region FE	Y	Y	Y	Y
Cohort FE	Y	Y	Y	Y
Community FE		Y	Y	Y
Child age FE		Y	Y	Y
Child sex dummy		Y	Y	Y
Urban dummy		Y	Y	Y
Parent's age and literacy			Y	Y
Head age, sex, and education			Y	Y
Additional controls				Y

Note: In all regression results robust standard errors are reported. Standard errors are clustered at the district (Woreda) level for column 1. For columns 2, 3, and 4, which include community fixed effects, they are clustered at community (Kebele) level. Additional controls include wealth index, household size, number of milk animals, number of livestock, at each of 2002, 2006, and 2009 survey rounds. Also, household reported share of food expenditure and droughts in 2006 and 2009 and land ownership in hectare in the 2006 survey rounds are included. The former two variables are not observed at 2002 survey round while the latter variable is observed only in 2006. ”Y” means Yes. The same note applies to all tables unless otherwise mentioned.

In addition to height-for-age as proxy for child health and nutrition, child stunting is defined as a binary outcome variable that indicates whether a childs height-for-age falls below a threshold defined by a WHO reference group of normally healthy children (WHO, 2006). A small reduction in the height-for-age z-score does not necessarily imply stunting unless that reduction is large enough that a childs height falls below -2 or -3 standard deviations. The probability of stunting is therefore estimated as a probit model. Accordingly, exposure to war increases the probability of child stunting by about 11-14 percentage points. This effect is statistically significant and robust to including community fixed effects and child and household covariates. Similar to the height-for-age results, the effect of war is larger and statistically significant for the rural sample compared to the urban sample. The correlation between stunting and war is higher for girls than for boys, but this difference disappears for the specification that includes all covariates (4th column).

Table 4: The impact of war on child health and nutrition Probit marginal effects: Dependent Variable is 1 if child is stunted, 0 otherwise

All Sample	1	2	3	4
born before war*war region	0.13**	0.14**	0.13**	0.11**
	[0.06]	[0.05]	[0.06]	[0.06]
N	2,812	2,812	2,170	2,141
Rural Sample				
born before war*war region	0.19**	0.19**	0.15*	0.13*
	[0.08]	[0.07]	[0.08]	[0.08]
N	1,730	1,730	1,439	1,423
Urban Sample				
born before war*war region	0.05	0.03	0.11**	0.06
	[0.06]	[0.04]	[0.06]	[0.05]
N	1,082	1,082	731	718
Girls Sample				
born before war*war region	0.16**	0.16**	0.15	0.13
	[0.08]	[0.08]	[0.10]	[0.09]
N	1,341	1,341	1,005	992
Boys Sample				
born before war*war region	0.11	0.11	0.11	0.12*
	[0.08]	[0.07]	[0.07]	[0.07]
N	1,471	1,471	1,165	1,149
Region FE	Y	Y	Y	Y
Cohort FE	Y	Y	Y	Y
Community FE		Y	Y	Y
Child age FE		Y	Y	Y
Child sex dummy		Y	Y	Y
Urban dummy		Y	Y	Y
Parent's age and literacy			Y	Y
Head age, sex, and education			Y	Y
Additional controls				Y

Note: Marginal effects are dy/dx at mean values of xs. Coefficients from OLS or LPM (not reported) are similar to the probit marginal effects. This note applies to all other tables that use Probit marginal effects.

4.2 Child education outcomes

The impact of war on child education outcomes are presented in tables 5 to 7. The OLS estimates in table 5 indicate that a child exposed to war completes about 0.7 fewer grades. This effect is consistently robust to including any of the covariates, as well as the choice of sub-sample (gender and rural-urban). This large magnitude and high statistical significant, insensitive to time variant and fixed effect characteristics, implies the intensity of the war was serious enough to be able to interrupt either child school enrolment or grade completion ability or both. Indeed, the next table confirms significant reduction in child enrolment.

Table 5: The impact of war on child schooling outcomes (OLS) Dependent Variable: No. of highest grade completed by child

All Sample	1	2	3	4
born before war*war region	-0.69***	-0.68***	-0.70***	-0.69***
	[0.14]	[0.15]	[0.19]	[0.19]
N	2,812	2,812	2,170	2,141
Rural Sample				
born before war*war region	-0.71***	-0.72***	-0.70***	-0.70***
	[0.16]	[0.17]	[0.22]	[0.23]
N	1,730	1,730	1,439	1,423
Urban Sample				
born before war*war region	-0.63***	-0.46***	-0.55***	-0.53***
	[0.13]	[0.14]	[0.14]	[0.14]
N	1,082	1,082	731	718
Girls Sample				
born before war*war region	-0.68***	-0.67***	-0.69***	-0.66***
	[0.12]	[0.13]	[0.15]	[0.14]
N	1,341	1,341	1,005	992
Boys Sample				
born before war*war region	-0.69***	-0.69***	-0.73***	-0.72**
	[0.19]	[0.22]	[0.26]	[0.27]
N	1,471	1,471	1,165	1,149
Region FE	Y	Y	Y	Y
Cohort FE	Y	Y	Y	Y
Community FE		Y	Y	Y
Child age FE		Y	Y	Y
Child sex dummy		Y	Y	Y
Urban dummy		Y	Y	Y
Parent's age and literacy			Y	Y
Head age, sex, and education			Y	Y
Additional controls				Y

Table 6 shows that children exposed to war are at least 32 percentage points less likely to be enrolled in school, and this effect remains robust to all specifications both in magnitude and statistical significance (at a 1 percent level). Similar to grade completion, this effect remains robust to using sub-samples for boys and girls separately. However, the effect of war on child enrolment is relatively small for the urban sub-sample as compared to the rural sub-sample.

Table 6: The impact of war on child schooling outcomes Probit marginal effects: Dependent Variable is 1 if child is currently enrolled in school, 0 otherwise

All Sample	1	2	3	4
born before war*war region	-0.32***	-0.36***	-0.38***	-0.37***
	[0.11]	[0.10]	[0.10]	[0.09]
N	2,812	2,812	2,170	2,141
Rural Sample				
born before war*war region	-0.45***	-0.44***	-0.45***	-0.45***
	[0.14]	[0.15]	[0.14]	[0.12]
N	1,730	1,730	1,439	1,423
Urban Sample				
born before war*war region	-0.09**	-0.06	-0.12***	-0.10**
	[0.05]	[0.05]	[0.05]	[0.05]
N	1,082	1,082	731	718
Girls Sample				
born before war*war region	-0.39***	-0.37***	-0.43***	-0.39***
	[0.11]	[0.12]	[0.09]	[0.09]
N	1,341	1,341	1,005	992
Boys Sample				
born before war*war region	-0.28**	-0.35***	-0.35***	-0.37***
	[0.12]	[0.12]	[0.12]	[0.11]
N	1,471	1,471	1,165	1,149
Region FE	Y	Y	Y	Y
Cohort FE	Y	Y	Y	Y
Community FE		Y	Y	Y
Child age FE		Y	Y	Y
Child sex dummy		Y	Y	Y
Urban dummy		Y	Y	Y
Parent's age and literacy			Y	Y
Head age, sex, and education			Y	Y
Additional controls				Y

Looking at literacy, exposure to war increases the probability of a child having reading problems by about 21 percentage points (table 7). This effect is similar for all specifications (columns 1-4) and for all sub-samples. The effect on learning outcomes could be driven by the previous results of reductions in school enrolment and grade completion, but might also be due to deteriorating quality of schooling or related to psychological stress of the war experience. This could also be due to immediate ceasing of the school from on going teaching and learning process at times intensity of the war worsens.

Table 7: The impact of war on child literacy outcomes Probit marginal effects: Dependent Variable is 1 if child has problems with reading, 0 otherwise

All Sample	1	2	3	4
born before war*war region	0.21***	0.23***	0.24***	0.23***
	[0.06]	[0.06]	[0.07]	[0.07]
N	2,812	2,812	2,170	2,141
Rural Sample				
born before war*war region	0.24***	0.23***	0.20**	0.19**
	[0.09]	[0.08]	[0.09]	[0.09]
N	1,730	1,730	1,439	1,423
Urban Sample				
born before war*war region	0.21***	0.17***	0.24***	0.24***
	[0.06]	[0.04]	[0.05]	[0.05]
N	1,082	1,082	731	718
Girls Sample				
born before war*war region	0.22***	0.21***	0.22***	0.23***
	[0.08]	[0.07]	[0.08]	[0.09]
N	1,341	1,341	1,005	992
Boys Sample				
born before war*war region	0.19***	0.24***	0.24***	0.22***
	[0.06]	[0.06]	[0.06]	[0.05]
N	1,471	1,471	1,165	1,149
Region FE	Y	Y	Y	Y
Cohort FE	Y	Y	Y	Y
Community FE		Y	Y	Y
Child age FE		Y	Y	Y
Child sex dummy		Y	Y	Y
Urban dummy		Y	Y	Y
Parent's age and literacy			Y	Y
Head age, sex, and education			Y	Y
Additional controls				Y

Overall, the sign of these estimated impacts of war on child health (and nutrition) are consistent with studies from other countries. For instance, Bundervoet et al., (2009) find a -0.35 standard deviation in height-for-age impact of civil war in rural Burundi. Similarly, Akresh et al. (2011) find -1 standard deviation in height-for-age z-scores from Rwanda while Akresh et al. (2012) find -0.44 standard deviations in height-for-age z-scores of the Ethiopian-Eritrean war on children in Eritrea. This consistency of estimates suggest that there is an external validity to the literature on the impact of war on childhood human capital. Indeed, the impact is negative and significant. However, this study finds relatively smaller coefficient. This implies the coefficients are estimated with less upward bias by using same age children from the panel data. Clearly, regression results from the pooled sample that uses all children shows higher coefficients - about 0.5 standard deviations in height-for-age z-scores (results are available but not shown to save space).

There are a limited number of studies that look at the impact of war on child educational outcomes, such as grade completion, school enrolment and literacy, using (child) household data (e.g. Verwimp and Van Bavel, 2013, and Justino et.al., 2013). This study provides robust empirical evidence of the negative impact of war on child educational outcomes.

5 Conclusion

This paper investigates some of the channels - childhood health and schooling outcomes - through which the Eritrean-Ethiopian war may have negative intergenerational economic impacts. Using the Young Lives data set of children from poor households in Ethiopia and combining event data with location, this study compares changes in outcomes between old (war-exposed) and young (non-war-exposed) cohorts at the average age of eight, in war-affected and non-affected regions after controlling for possible observables. This difference-in-difference approach provides two primary benefits for identifying impact estimates of the war. First, this method avoids any bias due to time-constant unobserved heterogeneity across regions. Second, after controlling for possible observable trends, the analysis compares cohorts of the same average ages, minimizing the upward bias due to non-linearity of age in the growth process of children.

The results show that children who were exposed to the war stunted growth than children that were not directly exposed to the war. In addition, exposed children completed fewer grades, are less likely to be enrolled in school, and more likely to show reading problems. These are substantial impacts especially for children from poor backgrounds as poverty may limit their potential of recovery.

Girma and Kedir (2005) estimate average returns to an additional year of schooling in Ethiopia to range from 9.2 to 19.6 percent in terms of wages. Assuming one year of schooling is equivalent to one grade completed, these estimates suggest that in the long term war may reduce wage by about 10 percent during adulthood for war exposed children.

Evidence of the detrimental impact of war on human capital of children emphasises that interventions that protect welfare of children growing up in war-affected regions need to be available and further encouraged. These interventions include immediate policy responses as well as post-war rehabilitation programs. First, governments and other responsible international organizations need to develop interventions or programs to ensure that children are physically protected or evacuated from conflict areas. Second, priority should be placed with targeting children at risk of malnutrition because of family displacement or loss of life. Third, appropriate psychological interventions to healing post-war trauma should be considered. Fourth, post-war infrastructural developments can aid the recovery process, such as repatriation programs to help improve physical and psychological welfare of children, and (re-)constructing schools, health centres, and roads to improve health and education of children. The speed and coordination with which these organizations respond to such crises is important in protecting children during war and armed conflict.

While this paper has quantified the total effect of war on childrens human capital, it remains difficult to flesh out the exact mechanisms driving the results due the complexity of the war context and limited data availability (especially pre-war). Future research that focusses on mechanisms by which war affects children may improve the design of appropriate policy on how to target and support children confronted with war.

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