

# Armed Conflicts, Children's Education and Mortality: New Evidence from Ivory Coast

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Published online: 26 July 2016  
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**Abstract** Among the sub-Saharan African countries, Ivory Coast has suffered more than 10 years of political instability and absence of peace. Using nationally representative household surveys, this study exploits temporal and geographical variations of the 1999–2011 Ivorian political instability to identify its causal effect on children's schooling and child mortality. The results showed that individuals who lived in conflict areas and who reached the official age to be enrolled in school within the period of the instability had a 10 % lower probability of being enrolled in school. Students who spent their school years during the conflict and who lived in an affected area experienced a lag in schooling attainment of more than a year. Older students or those who were likely to be in high school during the conflict underwent a loss in schooling attainment of nearly 2 years. In addition, results showed that the Ivorian armed conflict increased the mortality of children under age five by at least 3 %. My results also suggest that the deterioration of living conditions and the limitation of health service use during the conflict contributed to the explanation of these adverse effects. Placebo tests suggested that the results were not driven by preexisting differences across conflict and non-conflict areas.

**Keywords** Conflicts · Children · Education · Mortality · Ivory Coast · Sub-Saharan Africa

“Places of learning and places of healing should never be places of war”, Ban Ki-Moon, UN Secretary General, July 2011.<sup>1</sup>

## Introduction

Africa, the poorest continent in the world, is also the most affected by conflicts and political instabilities. According to the World Bank, among developing countries affected by conflicts, 46 % are in Africa.<sup>2</sup> In recent decades, three quarters of African countries have been affected by armed conflicts (Gleditsch et al. 2002). These conflicts often erupt after the seizure of power by civil (Ivory Coast 2000, Central African Republic 2013) or military (Burkina Faso 1966, 1980, 1982, 1983, 1987; Ivory Coast 1999, 2011) factions following disputed elections or coups.

Armed conflicts have dramatic consequences on economic development by destroying private and public infrastructures. The destruction of schools and health infrastructures, along with housing, has a direct effect on schooling and health for exposed populations. Moreover, according to a World Bank report, the economic and social costs of conflict persist for years after the end of the conflict (World Bank 2003).

In peacetime, it is generally accepted that children need special protection because they are considered the most vulnerable sub-population. If this is accepted to be true in peacetime, this should be all the more true during periods

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<sup>1</sup> Security Council meeting on Children and Armed Conflict 12 Jul. 2011 ([http://www.un.org/apps/news/story.asp?NewsID=39013#\\_VDrdMdTF-lp](http://www.un.org/apps/news/story.asp?NewsID=39013#_VDrdMdTF-lp) (last accessed April, 2014)).

<sup>2</sup> <http://go.worldbank.org/SQ4KUOKGP0> (last accessed April, 2014).

of conflict. Armed conflicts affect children's education and health in several ways. First, children are not immune to the killings and mutilations among exposed populations, and orphans are more likely to leave school (Evans and Miguel 2007; Kobiané et al. 2005). Second, it is not uncommon to see fighters forcibly recruiting children for use as soldiers in conflicts (Honwana 2006). In the same context, girls are often victims of rape and other forms of sexual violence. Under these conditions, even if schools are not officially closed, children may be discouraged from going to school because of personal insecurity. Third, during conflicts, schools and hospitals are often attacked, destroyed, or seized as headquarters by fighters (Kibris and Metternich 2016). Children whose schools are destroyed might be forced to interrupt their education. Finally, conflicts have a negative effect on growth (Gupta et al. 2004) and, therefore, negatively affect resources of exposed populations. The reduction of families' resources has negative effects on children's schooling and health (Jacoby and Skoufias 1997; Thomas et al. 2004; Thomas 1994). All these events can lead to a marked reduction in the level of schooling, and to an increase in the mortality rate among young children.

Ivory Coast was recently affected by more than 10 years of political instability and absence of peace, beginning with a coup in 1999 and continuing until 2011 with civil war, armed militias and rebellions. This study examines temporal and geographical variations of Ivorian political instability from 1999 to 2011 to identify causal effects on children's outcomes as measured by schooling and mortality. Two school outcomes were used: school enrolment and school attainment. The former is defined as the probability of being enrolled in school for school-age youth, while school attainment is defined by the number of years of schooling for children who have been enrolled in school. Child mortality is defined by the probability that a child dies before reaching the age of five.

Studies on the link between armed conflicts and children's education or health have been conducted at both the macro and the micro levels. Ichino and Ebmer (2004) analyzed the long-run educational cost of World War II. They found that Austrian and German individuals who were 10 years old during the conflict, or were more directly involved in the conflict through their parents, received less education than comparable individuals from Switzerland and Sweden who did not participate directly in the conflict (Ichino and Ebmer 2004). Using repeated cross-sectional datasets for 43 countries in Africa, Poirier (2012) showed that conflict and especially civil war had a strong and negative effect on school attendance and secondary school enrolment. Bundervoet (2012) using a panel of children during Burundi's civil war showed that the effect of the conflict on children education was particularly salient for

the older children who were most exposed to violence in their early childhood years. Oyelere and Wharton (2013) by focusing on internally displaced persons during the internal armed conflict in Colombia, found a significant education accumulation gap for children of internally displaced persons compared to non-migrants that extended to approximately half a year at the secondary level. More recently, Guariso and Verpoorten (2015) indicated that the conflicts in Rwanda caused, on average, a 22 % drop in schooling attainments, corresponding to about one year less of education, and that the drop was relatively larger for girls. Regarding child mortality, Macassa et al. (2003) described urban and rural trends of infant, child and under-five mortality in Mozambique (1973–1997) by mother's place of residence. They found that the civil war could be a possible cause of the increase of the difference in mortality between urban and rural areas over time until 1988–1992. Degomme and Guha-Sapir (2010) analyzed changes over time for crude and cause-specific mortality rates, and assessed the effect of displacement on mortality rates in the Darfur conflict. Their results showed that in general, the reduction in rate was more important for violence-related than for diarrhea-related mortality. Ascherio et al. (1992) using data from Iraq provided strong evidence that the Gulf war and trade sanctions caused a threefold increase in mortality among Iraqi children under 5 years of age.

However, in macroeconomic studies, the impact of conflicts might be confused with the effects of other phenomena. Further, these studies can disguise some realities of the impact of conflict. Indeed, according to Akresh and De Walque (2008), while school enrolment trends suggested that the school system recovered quickly after the Rwandan genocide in 1994, a difference-in-difference analysis with micro-data showed that children exposed to the genocide experienced almost a half-year decline in schooling attainment and were 15 % less likely to complete third or fourth grade. In a more recent study, Shemyakina (2011) examined Tajikistan's 1992–1998 armed conflict finding that school-age girls who lived in affected regions were less likely to be enrolled in school and to complete their mandatory schooling than girls of the same age who lived in the regions relatively unaffected by conflict. The impact of Ivorian conflict on children's education was previously explored by Dablean and Paul (2012). In their study, they used individuals exposed to Ivorian conflict between 2002 and 2006 by distinguishing the younger cohort from the older one within the same survey. Their results indicated that the average number of years of education for a school-going age cohort was .94 of a year lower than an older cohort in war-affected regions.

The impact of armed conflict on health was addressed by Bundervoet et al. (2009) and Verwimp (2012) in Burundi; Mansour and Rees (2012) in Palestine; Akresh et al. (2011)

in Rwanda; Akresh et al. (2012) in Eritrea; Parlow (2012) in Kashmir; Tranchant et al. (2014) in India; and Minoiu and Shemyakina (2014) in Ivory Coast. All these studies used anthropometric measures, particularly child's height-for-age Z-scores or child's weight as health measures. Their results are qualitatively the same. Indeed, these studies arrived at the same conclusion, namely that conflict-exposed children had lower height-for-age Z-scores or lower weight compared to children not exposed to conflict.

Despite the relatively large number of these studies, no study has focused on infant and child mortality. Further, most of the studies on education did not take into account the probable pre-existence of province-level trends in children's schooling. This study provides several contributions to the literature. First, to the best of my knowledge, this is the first micro-econometric study focused on armed conflict and child mortality. If adult death due to armed conflict is most often directly linked to armed attacks, the deaths of young children, due to their fragility, can also be indirectly driven by the degradation of living conditions during conflicts and thus more difficult to measure. Household micro-data allowed this indirect effect to be taken into account. Second, previous studies generally used household members' statements to identify individuals affected by the conflict, so their results were highly dependent on the quality of those statements. To avoid this concern, information on conflict events were drawn from a separate dataset built through several sources (war zones, humanitarian agencies, and research publications). This dataset contains information on the number of conflict events at several administrative levels. Third, unlike previous studies on armed conflicts and children's education, my identification strategy takes into account the probable pre-existence of province-level trends in children's schooling. Not taking into account these probable trends, is to assume that changes between children exposed to the conflict period and those not exposed would have been the same in both conflict and non-conflict areas. This could be a strong assumption in the case of Ivory Coast, because conflict-affected areas were more likely to be urban. Finally, in addition to covering the entire period of the political disorder (from 1999 to 2011), the data used in this study allowed me to perform a robustness check through a placebo test. Indeed, data from 1994 (4 years before disorder), 1998–1999 (just before disorders) and 2011–2012 (just after the end of the conflict) were used. While the two last data sources were used to estimate the effect of the instability, the first two data sources allowed me to perform a placebo test.

My results showed that Ivorian political instability had a strong negative impact on children's education and a positive effect on children's mortality. Indeed, the results showed that children who spent at least one of their first

5 years during the period of instability and lived in affected areas had a 3.5 % higher chance of dying before reaching age five. Regarding children's education, children who reached the official age to be enrolled in school within the period of disorders and living in areas affected had a 10 % lower chance of being enrolled in school. School-age students during the conflict and who lived in affected areas experienced more than a year's drop in average years of schooling. The impact was greater for older students, who experienced almost 2 years drop of average years of schooling. Regrading mechanisms, my results suggested that the deterioration of living conditions and the limitation of health service use during the conflict contributed to explain these adverse effects.

### History of Conflict in Ivory Coast from 1999 to 2011

A country long considered one of the most stable in West Africa, Ivory Coast experienced political instability between 1999 and 2011 marked by coups, civil war, and a rebellion. In this study, Ivorian conflict is defined as the political instability that started with the 1999 coup, followed by the rebellion. It take into account all events involving military attacks, civil war, armed militias, and armed groups. Therefore, the Ivorian conflict can be summarized in three phases.

The first phase concerns the period 1999–2001 which was marked by military coups.<sup>3</sup> After the 1993 death of the country's first president, Félix Houphouët-Boigny, Henri Konan Bédié succeeded him as president. Bédié was quickly accused of creating an ethnic division by curbing the political rights of Ivorian people from the north who were assimilated with some immigrants from neighboring countries; and promoting the concept of *ivoirité* or *ivoirity*.<sup>4</sup> The preparations for the 2000 presidential campaign thus took place in an ethnicized context, which caused tensions between people from the north and the south of Ivory Coast. A military mutiny on December 23, 1999 became a coup the following day. General Robert Guei, promoted to president, announced the establishment of a national committee of public safety. After the seizure of power by Guei, the concept of Ivorian was further enhanced by the adoption of a new constitution which excluded the possible candidacy of Alassane Ouattara, a northern political leader. This gambit led to heavy fighting throughout the country between Ouattara partisans and

<sup>3</sup> <http://www.un.org/en/peacekeeping/missions/past/minuci/background.html> (last accessed April 2014).

<sup>4</sup> *ivoirité* was a concept which distinguishes indigenous people from migrants.

those supporting the southerner Laurent Gbagbo. The 2000 presidential election opposed Robert Guei and Laurent Gbagbo. After the election, each candidate declared victory and proclaimed himself president. This led to violence, mainly in Abidjan. The army recognized Laurent Gbagbo as the winner of the election. After organizing legislative and municipal elections without Alassane Ouattara's political party, this first step of the crisis ended in 2001 by a forum for national reconciliation designed to end tensions.

The second phase covers the 2002–2007 period, which was marked by rebellion in the north (United Nations 2006a; United Nations 2006b). Despite the establishment of a Forum for National Reconciliation, questions of nationality and voting rights were not addressed and northerners felt forsaken by the government. In September 2002, a group of soldiers from the largely-Muslim north (mostly populated by Muslims), attempted to seize power in Abidjan. Several rebel attacks took place in Abidjan, but the coup failed and the rebels retreated to the north. The slums of the Ivorian capital, populated mostly by Muslims and immigrants from West Africa, were burned. Several months of fighting followed, and there was violence in several cities including Abidjan in the south, Bouaké in the center, and Korhogo in the north. Throughout the conflict period, Ivory Coast was divided in two: The northern part was administered by the rebels with Bouaké as its capital while the southern part remained under the control of the government.<sup>5</sup> Beginning in 2004, an intervention of the international community reduced the attacks from both camps. The country entered a period of neither peace and nor war in which several mediations were undertaken. In 2007, the protagonists signed an agreement in Ouagadougou (Burkina Faso) for the formation of a new government incorporating the main political actors in the country, including the rebels. This agreement also included the participation of all political actors in the next presidential elections. The agreement was intended to bring an end to the war and lead to free and fair elections.

The third phase concerns the 2008–2011 period or presidential election period. It was characterized by the coexistence of the protagonists in the same government with an eye to the 2010 presidential elections. Though country still remained divided in two, until 2010 there was a relatively peaceful climate throughout the country. In December 2010, the presidential election took place and Alassane Ouattara was announced the winner by the electoral commission, but the constitutional council rejected the results and declared Gbagbo the winner. After several failed mediations, the conflict between former rebels and government forces flared up again in the capital and several other cities. The United Nations recognized Alassane

Ouattara as the legitimate winner.<sup>6</sup> Faced with the refusal of the former president to recognize his defeat, the United Nations, through a resolution, authorized the intervention of international forces. Former President Laurent Gbagbo was arrested in April 2011 and in May 2011 Alassane Ouattara was sworn in as the new president of Ivory Coast, marking the official end of the conflict. According to the report of the National Commission of Inquiry, implemented after Ouattara's investiture, the post-election crisis claimed the lives of more than 3000 citizens (National Commission of Inquiry 2012).

The United States Institute of Peace reported that thousands of stakeholders including students and teachers were barred access to the education system during the conflict and that the education sector itself was seriously damaged (Sany 2010). In 2005, it was estimated that between 800,000 and one million children were receiving no education.<sup>7</sup> Even university students were not exempt from disruption, as universities were often looted or closed during the conflict (Sany 2010).

It is important to take into account the possible endogeneity of the conflict. If poor living conditions or educational inequalities are at the root of the conflict, this causes a reverse causality, which could bias the results. However, for the case of Ivory Coast, this seems not to be the case. The main reason of the conflict seems to be political with the introduction of "ivoirité" whose initial goal, according to its advocates, was to strengthen national identity. Unfortunately, as this concept gained momentum, it ended up becoming a factor of exclusion from political participation and citizenship for some citizens alleged to be immigrants from neighboring countries. In 2010, Bah (2010) in *Democracy and Civil War: Citizenship and Peacemaking in Ivory Coast* argued that the conflict was largely driven by concrete political and social grievances over citizenship. Further, the conflict areas appeared to have better indicators compared to the non-conflict areas. So, poor living conditions or adverse educational inequalities did not probably drive the conflict.

## Data and Methods

### Data

Two types of data were used in this study: household data from the Ivory Coast Demographic and Health Surveys (DHS), and conflict events data from the Armed Conflict Location Events Data (ACLED).<sup>8</sup>

<sup>6</sup> <http://www.un.org/en/peacekeeping/missions/unoci/background.shtml>.

<sup>7</sup> [http://www.unicef.org/cote\\_divoire\\_summary2005.pdf](http://www.unicef.org/cote_divoire_summary2005.pdf).

<sup>8</sup> ACLED data are available on <http://www.acleddata.com/>.

<sup>5</sup> <http://www.onuci.org/pdf/CONTEXTE.pdf>.

ACLED dataset is used to identify areas affected by conflicts. It is a public collection of political violence data for developing states. These data contain information on dates and locations of violence, the event types, the groups involved, fatalities and changes in territorial control. Information is recorded on battles, killings, riots, and recruitment activities of rebels, governments, militias, armed groups, and protesters. The main sources of data are reports from war zones, humanitarian agencies, and research publications. Areas affected by Ivorian conflict are areas for which the ACLED data report at least one conflict event from December 1999 to May 2011. Unlike Minoiu and Shemyakina (2014), who used the same data to investigate the impact of the conflict on children's health, small administrative level at which events occurred rather than the regional level is used. This allowed me to focus only on areas affected by events. Figures 1 and 2 show maps of Ivory Coast with areas affected by the conflict from December 1999 to May 2011 by small administrative and regional levels, respectively. Darker shades are the most affected areas in term of frequency of conflict events. As Fig. 1 demonstrates, many areas in the country were impacted by violence, but the western, central, and to a lesser extent the southern parts of the country were most affected. As the maps make clear, employing the regional level for analysis is misleading because some unaffected areas are counted as affected areas when the administrative level becomes bigger.

The household data come from three surveys: the June–November 1994, September 1998–March 1999, and December 2011–May 2012 Ivory Coast Demographic and Health Surveys.<sup>9</sup> These are cross-sectional surveys with representative data at the national level. The analysis of the impact of conflict is conducted with the 1998–1999 and 2011–2012 data, while the 1994 data are used for a robustness check. Information on education is collected for each individual aged 6–24 years old, and includes past and current school attendance, current grade if still in school, and the highest grade attained by those no longer in school. Information for children's mortality comes from the birth histories of women 15–49 years old. The birth history gives information for all of a woman's children, including survival status and date of death if the child is deceased. Household data were merged with ACLED.

<sup>9</sup> More information on data availability can be found at <http://dhsprogram.com/Who-We-Are/About-Us.cfm>.

## Identification and Econometric Specification

Identification is based on the use of temporal and geographical variations of the Ivorian conflict. For each outcome, it consists of comparing the difference between exposed and unexposed individuals in conflict-affected areas to the difference between exposed and unexposed individuals in unaffected areas. Exposed to the conflict or exposed to the conflict period means that the individual was susceptible to the event in terms of schooling or mortality under five during the conflict period. Thus, exposed individuals come from the post-conflict dataset (2011–2012 survey). Not exposed to the conflict or to the period of the conflict means that the individual was not susceptible to the event in terms of schooling or mortality under five during the period of conflict. These individuals come from the pre-conflict dataset (2008–2009 survey).

### Empirical Strategy

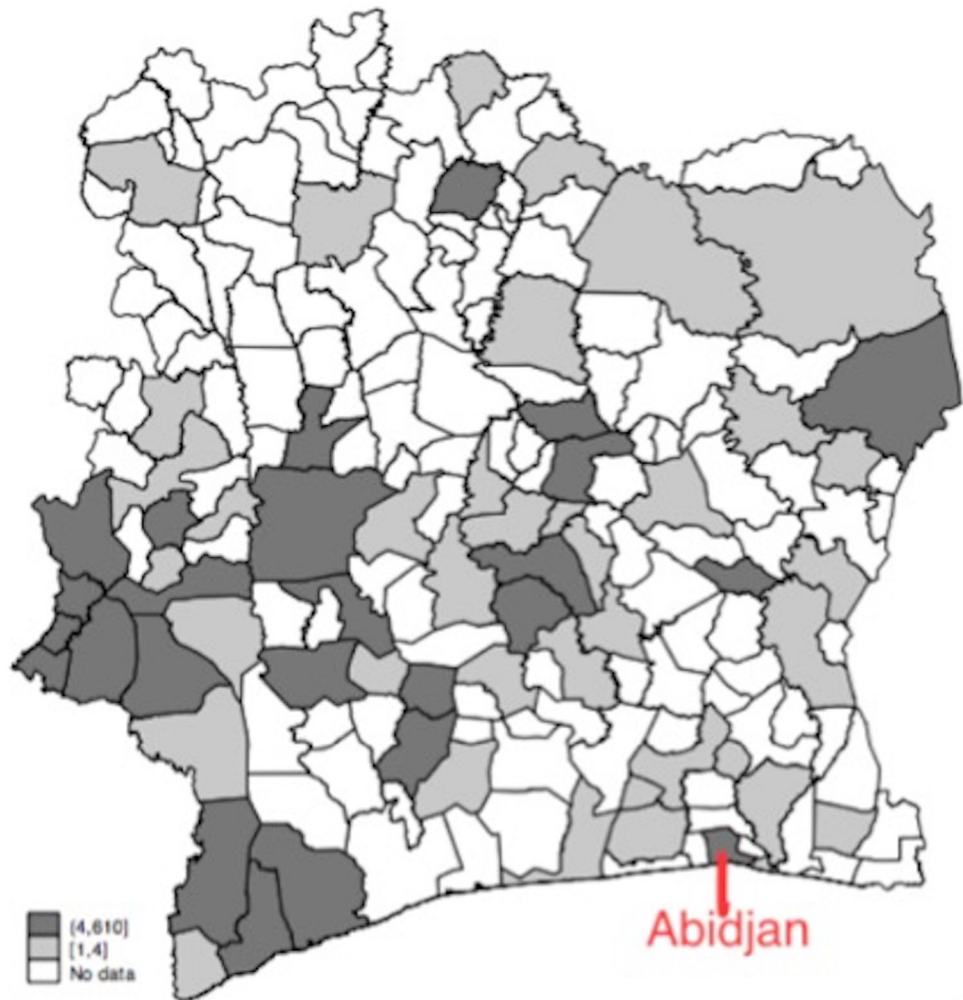
The following baseline specification with province and birth-cohort fixed effects is estimated:

$$Y_{ijt} = \alpha_j + \sigma_t + \beta_1 \text{Conflict}_j * \text{Post}_t + \varepsilon_{ijt}. \quad (1)$$

Where  $Y_{ijt}$  is children's outcomes, subscripts on the dependent variable denote individual  $i$  residing in the area  $j$  and born in year  $t$ ,  $\text{Post}_t$  is a dummy variable indicating the post-conflict data,  $\text{Conflict}_j$  is the dummy variable indicating conflict affected areas,  $\alpha_j$  is an area fixed effects,  $\sigma_t$  is a cohort of birth fixed effects, and  $\varepsilon_{ijt}$  is a random errors term. When the dependent variable is the number of years of schooling,  $Y_{ijt}$  is a discrete variable. However, in the case of school enrolment and children's mortality,  $Y_{ijt}$  is a probability that measures the probability of being enrolled in school (for school enrolment) and the probability of death before age five (for children's mortality). For these two outcomes, Eq. 1 becomes a Linear Probability Model (LPM).<sup>10</sup> These equations are estimated by OLS with robust standard errors.

<sup>10</sup> The Linear Probability Model has two main issues. First, fitted values can be outside the unit interval, although it should predict probabilities. Second, LPM implies that a ceteris paribus unit increase in the same covariate always changes the probability by the same amount. This would be not realistic, particularly with continuous covariates, but less problematic whenever covariates are discrete as in our case. Moreover, since my main purpose is to estimate the average effect of being exposed to the conflict and living in a conflict area on the probability that a child is enrolled in school and the probability that child dies before his fifth birthday, these two issues need not be a serious concern (Wooldridge 2010). Further the results show that of the 17732 fitted probabilities for children's mortality, only 334 are outside the unit interval. According to children's school enrolment 1176 over 19962 predicted probabilities are outside the unit interval. So, OLS with heteroscedasticity robust standard errors was used for estimation.

**Fig. 1** Map of conflict events from 1999 to 2011 in Ivory Coast (subregion level) *Source* Armed Conflict Location Events Data, 2013



In Eq. 1, the parameter of interest is  $\beta_1$  which captures the impact on children's outcomes of being exposed to the period of the conflict and residing in an area affected by the conflict. This first specification assumes that changes in children's outcomes between pre-conflict and post-conflict groups in conflict-affected areas would have been the same as changes between pre-conflict and post-conflict groups in non-conflict areas. To account for probable differential time trends in children's outcomes across areas, following Akresh et al. (2012), and Minoiu et al. (2012), an area-specific time trend was added into the previous equations. Further, individual and family characteristics which could differ between affected and unaffected areas are integrated. Therefore, Eq. 1 becomes:

$$Y_{ijt} = \alpha_j + \sigma_t + \gamma_{jt} + \beta_2 \text{Conflict}_j * \text{Post}_t + \beta_3 \text{Conflict}_j * \text{Post}_t * \text{Female} + \lambda X_i + \varepsilon_{ijt} \quad (2)$$

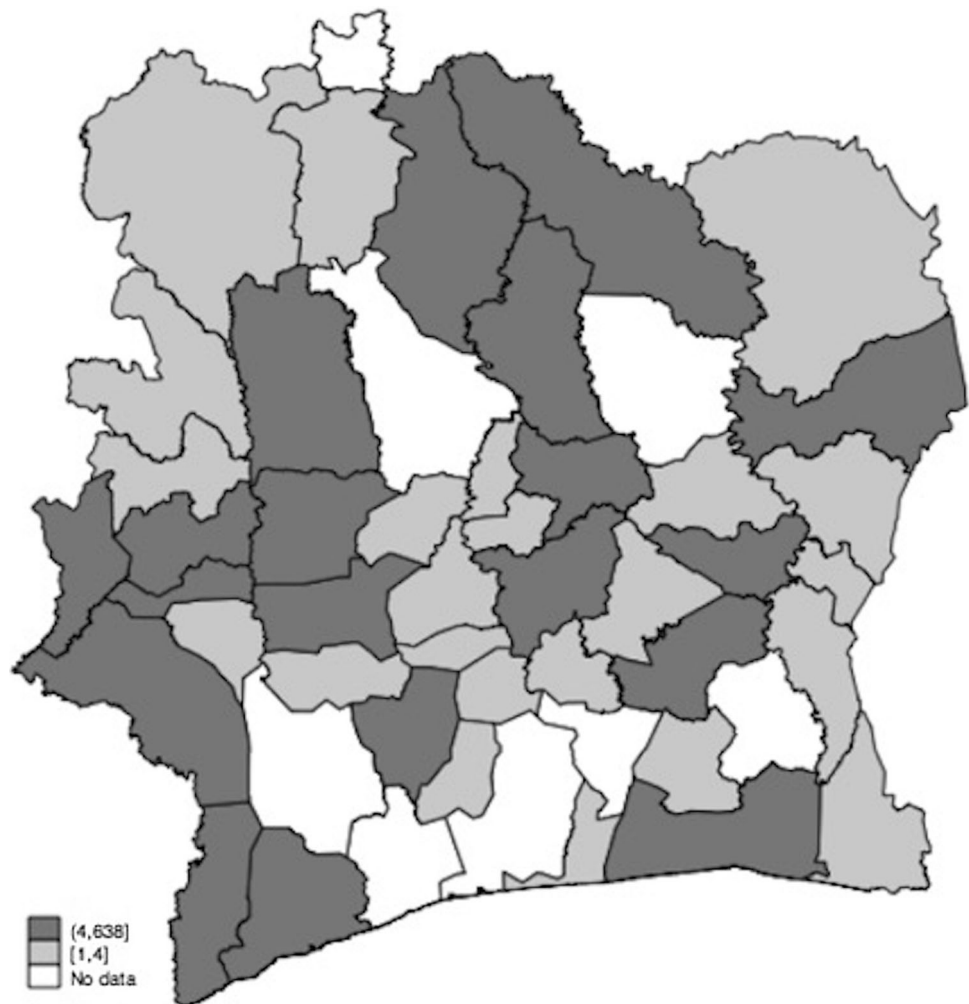
where  $\gamma_{jt}$  is an area\*year effect that controls for pre-existing trends in children's outcomes and  $X_i$  is a vector of individual

and family characteristics. In order to capture any possible gender gap in conflict impact the variables of interest ( $\text{Conflict}_j * \text{Post}_t$ ) has been crossed with a female dummy variable. The identification is based on the common trend assumption meaning that both areas-affected and not affected would have the same trend in the case of non-conflict. This assumption can be assessed with a placebo test. Assume for example that we have two pre-conflict datasets. In that case, by supposing that the conflict happened earlier the identification strategy could be applied with these two pre-conflict datasets. If there is no effect of this artificial conflict one could assume the common trend assumption to be verified. Therefore, because the conflict began in December 1999, the 1994 and 1998–1999 Ivory Coast DHS data are used to perform a placebo test.

#### *Definition of the Sample for Each Outcome*

This section defines the younger cohort to consider in the post-conflict data for each outcome.

**Fig. 2** Map of Conflict events from 1999 to 2011 in Ivory Coast (region level) *Source* Armed Conflict Location Events Data, 2013



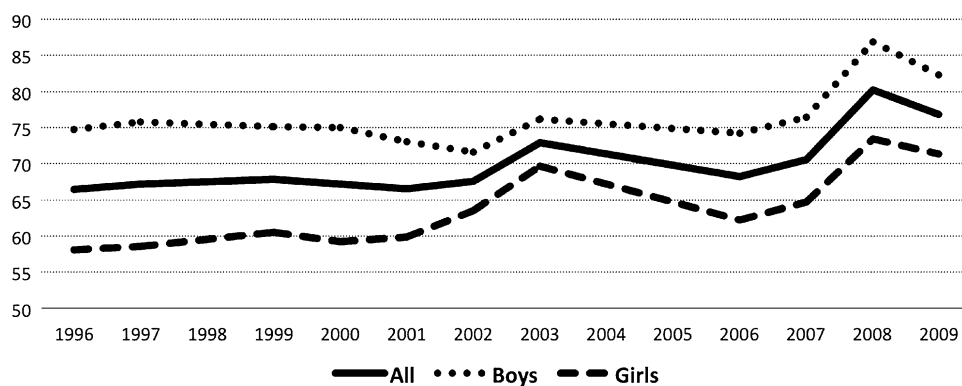
The exposition is referred to the period of the conflict. It identifies individuals to be considered in the post-conflict period. To define conflict exposure for school enrolment, all individuals likely to be enrolled in school throughout the conflict period are considered. The official age to be enrolled in school is six. According to this definition, a sample of children aged between 6 and 18 years old in 2011 (at the end of the conflict) was used. Children from 6 to 18 years old in 2011 reached the age of six within the conflict period. Therefore, the identification strategy was to compare school enrolment for individuals from 6 to 18 years old in 2011 from the 2011–2012 survey to individuals from 6 to 18 years old in 1998 from the 1998–1999 survey. The post-conflict or exposed group is a subset of individuals from 6 to 18 years old in 2011 from the 2011–2012 survey. The unexposed group is composed of individuals of the same age in 1998, according to the 1998–1999 survey. For instance, exposed people in unaffected areas are individuals from unaffected areas who reached the official age to be enrolled in school (6 years) within the conflict period. The unexposed people in

unaffected areas are individuals from unaffected areas who reached the official age to be enrolled in school outside the conflict period. The identification strategy consists in linking these individuals to the presence of conflict in the areas where they lived.

To analyze the impact of armed conflict on the number of years of schooling for those children enrolled in school, a sample of children who were of school age during the conflict and were enrolled in school was considered. Therefore, from the 2011–2012 survey, individuals from 6 to 24 years old at the beginning of the conflict (1999) and who were enrolled in school are identified as individuals from post-conflict data or exposed to the conflict period. These individuals are thus between 18 and 36 years old in 2011. This age was chosen to take into account all levels of education, including college and university. The subset of individuals from 18 to 36 years old in 1998 (from the 1998–1999 survey) is the unexposed group or pre-conflict group.

Regarding child mortality, the identification strategy consisted of comparing the survival of children at least

**Fig. 3** Evolution of first-grade enrolment rate (<http://data.un.org/Default.aspx>) Source UN data, 2012



5 years old or who would have been at least 5 years old if deceased and who lived at least one of their first 5 years in the conflict period, to the survival of children at least 5 years old or who would have been at least 5 years old if deceased and who did not spend any of their first 5 years in the period of the conflict. For example, a child who was 5 years old in 2011 would have been exposed to the conflict period during all 5 years, whereas children aged 16 in 2011 would have exposed to conflict for only one year of their first 5 years. So, individuals exposed to the period of the conflict or in the post-conflict group are a subset of children aged 5 to 16 in 2011 (from the 2011–2012 survey) or who would have been between 5 and 16 years in 2011 if deceased. The unexposed or pre-conflict group is, conversely, a subset of children from 5 to 16 years old or who would have been between 5 and 16 years old in 1998 (from the 1998–1999 survey).

### Descriptives Statistics

Figure 3 shows the evolution of the gross enrolment rate in the first grade of primary school from 1996 to 2009. Between 1999 and 2002, enrolment in the first grade decreased by nearly 4 % for boys but remained almost constant for girls. After a reversal in the trend between 2002 and 2003, the enrolment rate decreased significantly after 2003, particularly for girls, for whom there was a decline of approximately 7 %. These declines in enrolment rate occurred after the beginning of the first and second stages of the conflict, which led to a decrease in the overall primary school enrolment rate during the conflict (Fig. 5). Figure 4 represents the probability of being enrolled in school by age at the beginning of the conflict and conflict intensity. It shows that individuals less than 5 years old at the beginning of the conflict and living in conflict affected areas had less chance to be effectively enrolled in school. Because individuals more than 6 years of age at the beginning of the conflict were more likely to be already in school at the beginning of the conflict, we see that for these individuals the school enrolment rate was greater in

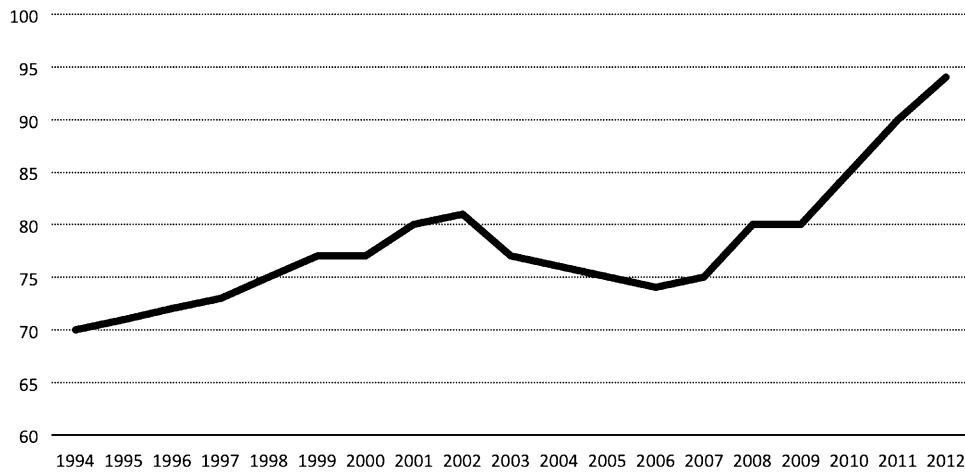
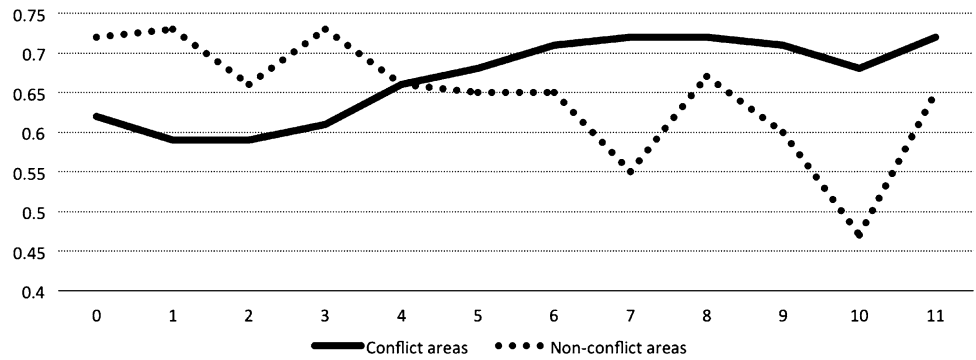
conflict areas as shown in the descriptive statistics. This suggests in a descriptive way that the conflict had an impact on school enrolment. Furthermore, Fig. 6 suggests that the armed conflict had a negative effect on the number of years of schooling for school-aged children. It plots by age and intensity of conflict the difference in number of years of schooling between children exposed to conflict and those not exposed. These differences indicate the evolution of the number of years of schooling, because individuals exposed to the conflict come from the 2011–2012 survey and those not exposed come from the 1998–1999 survey. Figure 6 clearly indicates there was an effect in the areas affected by the conflict. The evolution of the number of years of schooling was higher in the areas unaffected by conflict. In affected areas, the number of years of schooling decreased, mainly for individuals aged approximately 12–24 years when the conflict began. This finding suggests that conflict had a greater effect on older school-age individuals.

Table 1 shows descriptive statistics by intensity of conflict for each subsample. Conflict areas are defined as areas affected by the conflict. There are statistically significant differences in individual and family characteristics between conflict-affected areas and those not affected. Indeed, individuals from affected areas were more likely to be from urban areas and thus likely to be from families with higher standards of living and a head of household with more education. Additional characteristics linked to children's mothers are used for the mortality analysis<sup>11</sup> and also show statistically significant differences between affected and unaffected areas. To perform a robustness check, these variables were included as controls in the regressions for school enrolment and children's mortality. Family characteristics were not included in the specification for the number of years of schooling. The surveys contain only information on the current household in a

<sup>11</sup> Data for children's mortality come from the birth history module of DHS surveys. This module did not contain information about the child's relation to the head of household.

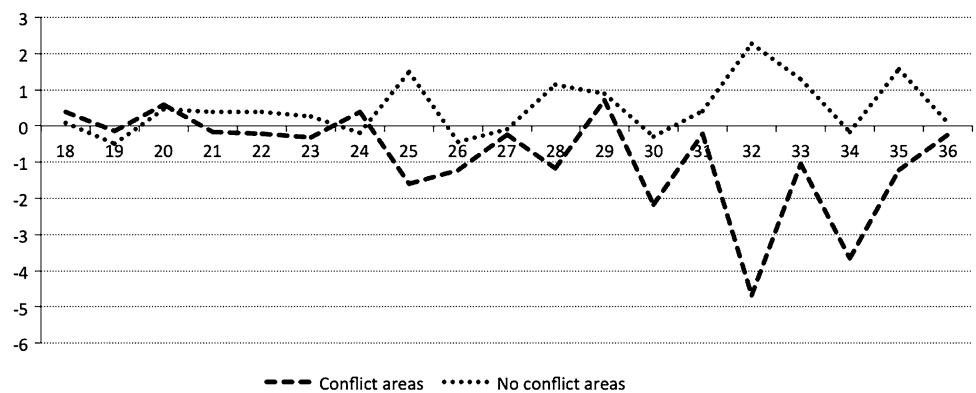


**Fig. 4** Enrolment in school and age at the beginning of the conflict in each area *Source* Ivory Coast DHS 2011–2012



**Fig. 5** Primary school enrolment rate (<http://data.un.org/Default.aspx>) *Source* UN data, 2012

**Fig. 6** Difference in number of years of schooling between Post-conflict and Pre-conflict by conflict areas and age *Source* Ivory Coast DHS 1998–1999 and 2011–2012



residence; current conditions might not accurately reflect conditions experienced by individuals during their school years.

Table 2 reports average values for each outcome by exposure to the conflict period and residence in conflict-affected areas. In general, for each outcome, as shown in the descriptive statistics, conflict areas had better indicators compared to those not affected by the conflict. Presumably, this reflects the fact that conflict areas are mainly urban

areas. However, unaffected areas experienced an improvement. In affected areas, we observed a decrease in the average number of years of schooling and an increase of the proportion of children who died before reaching age five. Furthermore, the overall difference-in-difference suggested that individuals who reached age six during the conflict and lived in conflict-affected areas were 12 % less likely to be enrolled in school. Those who were aged between 6 and 24 years old at the beginning of the conflict

**Table 1** Summary statistics

<i>Child's variables</i>	School enrolment				Children's Mortality				Number of years of schooling			
	(6–18 years old)				(5–16 years old)				(18–36 years old)			
	OC (1)	IC (2)	Diff. (1)–(2)	N	OC (1)	IC (2)	Diff. (1)–(2)	N	NC (1)	IC (2)	Diff. (1)–(2)	N
Child's age	10.89	11.27	−0.38***	19962	10.28	10.33	−0.05	17732	27.03	26.84	0.19	11275
Child is a girl	0.49	0.50	−0.01	19962	0.50	0.49	0.01	17732	0.40	0.44	−0.04**	11275
Lives in a rural areas	0.77	0.49	0.28***	19962	0.82	0.59	0.23***	17732	0.66	0.32	0.34***	11275
Child of head	0.58	0.58	0.00	19962	–	–	–	–	–	–	–	–
Head of household												
Head's age	49.25	48.99	0.26	19962	47.53	47.23	0.3	17732	–	–	–	–
Head is a woman	0.10	0.18	−0.08***	19962	0.10	0.15	−0.05***	17732	–	–	–	–
Not educated	0.65	0.57	0.08***	19962	0.67	0.6	0.07***	17732	–	–	–	–
Primary level	0.17	0.18	−0.01	19962	0.21	0.20	0.01	17732	–	–	–	–
Secondary or more	0.18	0.25	−0.07***	19962	0.12	0.19	−0.07***	17732	–	–	–	–
Family's standard of living												
Very low	0.22	0.16	0.06***	19962	0.25	0.21	0.04***	17732	–	–	–	–
Low	0.27	0.17	0.10***	19962	0.26	0.19	0.07***	17732	–	–	–	–
Middle	0.26	0.19	0.07***	19962	0.28	0.21	0.07***	17732	–	–	–	–
High	0.15	0.23	−0.08***	19962	0.13	0.22	−0.09***	17732	–	–	–	–
Very high	0.10	0.25	−0.15***	19962	0.07	0.17	−0.10***	17732	–	–	–	–
Child's mother												
Age	–	–	–	–	34.85	35.23	−0.38***	17732	–	–	–	–
Total children ever born	–	–	–	–	5.47	5.61	−0.14***	17732	–	–	–	–
Not educated	–	–	–	–	0.78	0.70	0.08***	17732	–	–	–	–
Primary level	–	–	–	–	0.17	0.21	−0.04***	17732	–	–	–	–
Secondary or more	–	–	–	–	0.04	0.08	−0.04***	17732	–	–	–	–

OC outside conflict areas, IC inside conflict areas, N number of individuals

\*  $p < .05$ ; \*\*  $p < .01$ ; \*\*\*  $p < .001$

**Table 2** Children's outcomes by exposure to conflict and conflict intensity

	Pre-conflict	Post-conflict	Diff.	Double diff.
School enrolment				
In conflict areas	0.66	0.70	0.04	−0.12***
Outside conflict areas	0.47	0.63	0.16	
Observations	4482	15480		
Number of years of schooling				
In conflict areas	9.23	8.38	−0.85	−1.42***
Outside conflict areas	6.63	7.20	0.57	
Observations	2820	8455		
Children's mortality				
In conflict areas	0.14	0.15	0.01	0.03**
Outside conflict areas	0.15	0.13	−0.02	
Observations	3939	13,793		

\*  $p < .05$ ; \*\*  $p < .01$ ; \*\*\*  $p < .001$

**Table 3** Impact of the conflict on school enrolment *Source* 1998–1999 and 2011–2012 Ivory Coast Demographic and Health surveys

	[1]	[2]	[3]	[4]
Conflict area and post-conflict	-0.15*** [0.02]	-0.15*** [0.02]	-0.10*** [0.02]	-0.11*** [0.03]
Conflict area and post-conflict and female				0.03 [0.04]
Child is female				-0.12** [0.04]
Child’s age fixed effects	Yes	Yes	Yes	Yes
Area fixed effects	Yes	Yes	Yes	Yes
Area-specific trends	No	Yes	Yes	Yes
Child and families’ characteristics	No	No	Yes	Yes
Observations	19,962	19,962	19,962	19,962

Robust standard errors in brackets

“Conflict area and Post-conflict” indicates a child living in an area affected by the conflict who reached his sixth year within the conflict period. “Conflict area and Post-conflict and Female” indicates a girl living in an area affected by the conflict and who reached his sixth year within the conflict period

\* p < .05; \*\* p < .01; \*\*\* p < .001

**Table 4** Impact of the conflict on the number of years of schooling *Source* 1998–1999 and 2011–2012 Ivory Coast Demographic and Health surveys

	[1]	[2]	[3]
Conflict areas and post-conflict	-1.14** [0.39]	-1.13** [0.39]	-1.77** [0.59]
Conflict areas and post-conflict and female			1.18 [0.75]
Child is female			-1.40** [0.43]
Child’s age fixed effects	Yes	Yes	Yes
Region fixed effects	Yes	Yes	Yes
Region-specific trends	No	Yes	Yes
Observations	11,275	11,275	11,275

Robust standard errors in brackets

“Conflict area and Post-conflict” indicates a child living in an area affected by the conflict who were of school age during the conflict period and were enrolled in school. “Conflict area and Post-conflict and Female” indicates a girl living in an area affected by the conflict who were of school age during the conflict period and were enrolled in school

\* p < .05; \*\* p < .01; \*\*\* p < .001

and were enrolled in school experienced an average drop of 1.42 years of schooling. Regarding mortality, the descriptive statistics indicated an increase of 3 % in the probability that a child died before turning five.

## Results

### Impact on Children’s Education

This section presents the results for school enrolment and school attainment. Table 3 presents OLS regression results for school enrolment for both Eqs. 1 and 2. Each regression

controls for child’s age fixed effects and area fixed effects. All regressions show that the Ivorian conflict had a significant and negative effect on children’s school enrolment. The coefficient of the interaction term between exposure to conflict and residence in conflict-affected areas was negative and statistically significant at the 1 % level. Indeed, Column 1, which does not include area-specific trends or child and family characteristics, indicates that children who reached 6 years old during the conflict period and lived in an affected area had 15 % lower likelihood of being enrolled in school. The results remain the same when area-specific trends are included (Column 2). Controlling for child’s characteristics (gender, relation to head, type of

**Table 5** Impact of the conflict on the number of years of schooling for older students  
*Source* 1998–1999 and 2011–2012 Ivory Coast Demographic and Health surveys

	[1]	[2]	[3]
Conflict areas and post-conflict	−1.84**	−1.81**	−2.61**
	[0.56]	[0.56]	[0.82]
Conflict areas and post-conflict and female			1.55
			[1.05]
Child is female			−1.74**
			[0.54]
Child's age fixed effects	Yes	Yes	Yes
Region fixed effects	Yes	Yes	Yes
Region-specific trends	No	Yes	Yes
Observations	6977	6977	6977

Robust standard errors in brackets

“Conflict area and Post-conflict” indicates a child living in an area affected by the conflict who were of school age during the conflict period and were enrolled in school. “Conflict area and Post-conflict and Female” indicates a girl living in an area affected by the conflict who were of school age during the conflict period and were enrolled in school

\*  $p < .05$ ; \*\*  $p < .01$ ; \*\*\*  $p < .001$

residence such as rural or urban) and family characteristics (age of family head, gender, education, and family's standard of living), the coefficient of the interaction term declined from  $-0.15$  to  $-0.10$ , which implies a reduction by 10 % of being enrolled in school for children who reached the official age to be enrolled in school within the period of the to the conflict and living in affected areas. Finally, Column 4 does not show a gender difference in the impact of the conflict. Indeed, the interaction between exposure to the conflict, residence in conflict areas, and the female dummy did not show a significant difference between girls and boys. So, the impact of the conflict was similar for boys and girls. Overall, these results confirm the assumption that conflicts increase non-enrolment in school.

If school enrolment was negatively affected by the conflict, what about school attainment? In Ivory Coast, school-age youth are defined as follows: 6–11 years old for primary or basic school, 12–18 years old for high school, and 19–24 years old for college and university level. The impact of the conflict on school attainment is presented in Tables 4 and 5 for individuals aged 6 to 24 and 12 to 24 years old, respectively, at the beginning of the conflict. Column 1 in Table 4 shows the baseline regression results without controlling for area-specific trends. This regression yields a coefficient of  $-1.14$ , which is statistically significant at the 1 % level, suggesting that students from 6 to 24 years old at the beginning of the conflict who lived in conflict-affected areas experienced more than a one-year drop in average years of schooling. Column 2 in Table 4 includes area-specific trends and the type of place of residency. As with school enrolment, results do not show a gender difference (Column 3). Table 5 presents the results for youth from 12 to 24 years old at the beginning of the conflict. These students,

because of their age, had the potential of being directly involved in the conflict. They were also more likely to leave school for the labor market due to deteriorating living conditions during the crisis; for these two reasons, the conflict might affect these school-age students more than all school-age students. As Table 5 makes clear, students from 12 to 24 years old at the beginning of the conflict who lived in affected areas experienced a drop in average years of schooling of almost 2 years. Controlling for area-specific trends, the interaction between exposure to the conflict and residence in the affected areas led to a coefficient of  $-1.81$ , which is statistically significant at the level of 1 %. Again, this drop affected boys as well as girls.

### Impact on Child Mortality

Studies on the effects of shocks on children's health are documented in both the public health and development economics literatures. Shocks such as famines, recessions, pandemics, and conflicts reduce childhood health and affect work productivity later in life. Strauss and Thomas (2008); Victora et al. (2008) and Almond and Currie (2011) provided more detailed studies on the effects of shocks on children's health. In the specific case of conflicts, children's health is both directly and indirectly affected. In the presence of a conflict, the access to health care services such as vaccinations and other elements of prenatal care, is limited, despite its importance during pregnancy and after childbirth. Furthermore, the deterioration in family living conditions makes it difficult to supply nutrients essential for fetal development and early in the life of the child. Another channel through which conflict affects child's health is maternal stress during pregnancy (Camacho

**Table 6** Impact of the conflict on children’s mortality *Source* 1998–1999 and 2011–2012 Ivory Coast Demographic and Health surveys

	[1]	[2]	[3]	[4]
Conflict area and post-conflict	0.035 <sup>†</sup> [0.018]	0.039* [0.018]	0.033 <sup>†</sup> [0.018]	0.021 [0.027]
Conflict area and post-conflict and female				0.024 [0.037]
Child is female				−0.01 [0.031]
Child’s age fixed effects	Yes	Yes	Yes	Yes
Area fixed effects	Yes	Yes	Yes	Yes
Area-specific trends	No	Yes	Yes	Yes
Child and families’ characteristics	No	No	Yes	Yes
Observations	17,732	17,732	17,732	17,732

Robust standard errors in brackets

“Conflict area and Post-conflict” indicates a child living in an area affected by the conflict who aged at least 5 years old or would be aged at least 5 years old (if deceased) and who spent at least one of their first 5 years during the conflict period. “Conflict area and Post-conflict and Female” indicates a girl living in an area affected by the conflict who aged at least 5 years old or would be aged at least 5 years old (if deceased) and who spent at least one of their first 5 years during the conflict period

<sup>†</sup>  $p < .1$ ; \*  $p < .05$ ; \*\*  $p < .01$ ; \*\*\*  $p < .001$

2008), which can reduce the gestation period. These factors make children exposed to conflicts, either in the womb or during infancy and earliest childhood, more vulnerable than those not exposed; they can result in higher mortality during the first years of life.

The regression results for child mortality are presented in Table 6. Child mortality is measured by the probability that a child died before reaching age five. Column 1 indicates that children who spent at least one year in the period of the conflict and lived in a conflict-affected area had a 3.5 % higher chance of dying before reaching age five. The estimated coefficient increases to almost 4 % and is statistically significant at the 5 % level when controlled for area-specific time trends (Column 2). The regression in Column 3 controls for the child and family characteristics previously used in Table 3, but also integrates maternal characteristics such as mother’s age, education, and total number of children ever born. Controlling for such characteristics leads to a coefficient of 3.3 %, which is statistically significant only at the 10 % level. Therefore, the Ivorian armed conflict led to an increase of at least 3 % of under-five children’s mortality. Column 4 suggests that girls and boys were not differently affected by the conflict in term of mortality.

**Mechanisms**

*Deterioration in Families’ Living Conditions*

In addition to the general feeling of insecurity, the mechanism driving lower school enrolment and school

attainment during the conflict could be linked to the deterioration in families’ living conditions and the higher number of orphans in conflict-affected areas. Table 7 compares the standard of living of families in affected and non-affected areas between 1998–1999 and 2011–2012. The standard of living index is a combination of a number of socioeconomic resource factors such as housing characteristics and assets owned by the family. In contrast to non-affected areas, families’ standard of living decreased in conflict areas. In fact, between 1998 and 2011, the proportion of families with low or very low standard of living increased in conflict-affected areas, while the proportion of families with high or very high standard of living decreased. However, in areas not affected by the conflict, these proportions remained approximately the same. Regressions 1 and 2 in Table 8 shows the impact of the conflict on the probability that an individual from 6 to 18 years old belongs to a family with low standard of living. As the above statistics seemed to show, the conflict had a negative impact on conditions of living. Indeed, individuals from 2011 to 2012 DHS survey (who were exposed to the period of the conflict) and lived in affected areas had a 15 % greater chance of belonging to a family with a low standard of living compared to same age individuals but not exposed to the period of the conflict or not living in a area affected by the conflict. Family economic needs arise in research as a contributing factor to school dropout in general (Rumberger and Lim 2008). The degradation of familial living conditions following the reduction of resources during conflicts negatively affects the demand for schooling. In addition to increasing the

**Table 7** Evolution of family standard of living, prenatal visits, and children's vaccinations

	Pre-conflict (1998/1999)	Post-conflict (2011/2012)	Diff.	Double diff.
Very low standard of living				
In conflict areas	0.09	0.22	0.13	0.06
Outside conflict areas	0.22	0.29	0.07	
Low standard of living				
In conflict areas	0.10	0.19	0.09	0.15
Outside conflict areas	0.32	0.26	−0.06	
Middle standard of living				
In conflict areas	0.17	0.21	0.04	0.01
Outside conflict areas	0.20	0.23	0.03	
High standard of living				
In conflict areas	0.32	0.20	−0.12	−0.09
Outside conflict areas	0.17	0.14	−0.03	
Very high standard of living				
In conflict areas	0.32	0.18	−0.14	−0.13
Outside conflict areas	0.09	0.08	−0.01	
Number of prenatal visits				
In conflict areas	4.94	4.19	−0.75	−0.84
Outside conflict areas	2.79	2.88	0.09	
Child has not health card				
In conflict areas	0.90	0.90	0.00	−0.07
Outside conflict areas	0.82	0.89	0.07	
Child received BCG vaccine				
In conflict areas	0.87	0.80	−0.07	−0.10
Outside conflict areas	0.71	0.74	0.03	
Child received Polio1 vaccine				
In conflict areas	0.85	0.86	0.01	−0.02
Outside conflict areas	0.78	0.81	0.03	
Child received Polio2 vaccine				
In conflict areas	0.74	0.78	0.04	0.02
Outside conflict areas	0.68	0.70	0.02	
Child received Polio3 vaccine				
In conflict areas	0.59	0.63	0.04	0.01
Outside conflict areas	0.51	0.54	0.03	

inability of households to pay school fees and other costs associated with education, the lack of resources is also associated with a higher opportunity cost of schooling for children. This opportunity cost becomes larger as children age, and increases the pressure for children to work and earn income for family needs.

#### *limitation of Health Service Use*

The deterioration of family living conditions, mentioned above, could also explain the increase of children's mortality. Maternal depression caused by conflict can decrease pediatric visits (Valluri et al. 2015). To explore other mechanisms that drive higher mortality among children under 5 years old in conflict-affected areas, information on

prenatal visits during pregnancies and children's vaccinations were used. Good prenatal care is essential to both maternal and fetal health. A lack of prenatal visits is associated with low birth weight babies, premature births, and babies who do not survive (World Health Organization, & UNICEF 2003). As noted, armed conflicts can negatively impact children's vaccination and prenatal care through the limitation of access to health care services and thus increase children's mortality. To determine if such effects occurred during the Ivorian conflict, a comparison of the evolution of prenatal visits and children's vaccination between areas affected by the conflict and those not affected was made. Table 7 shows the evolution of prenatal visits and children's vaccination in both area types. The number of prenatal visits is defined the number of prenatal

**Table 8** Conflict, family condition of living and children vaccine *Source* 1998–1999 and 2011–2012 Ivory Coast Demographic and Health surveys

	Low standard of living		BCG		Orphan
	[1]	[2]	[3]	[4]	
Conflict areas and post-conflict	0.20*** [0.03]	0.15*** [0.02]	-0.13* [0.06]	-0.10 <sup>†</sup> [0.06]	
Conflict region					0.007 <sup>†</sup>
Child’s age fixed effects	Yes	Yes	Yes	Yes	Yes
Region fixed effects	Yes	Yes	Yes	Yes	Yes
Child and families characteristics	No	Yes	No	Yes	Yes
Observations	19,962	19,962	19,962	19,962	14,668

Robust standard errors in brackets

“Conflict area and Post-conflict” indicates an individual from 2011 to 2012 DHS survey and lived in an area affected by the conflict. “Low standard of living” indicates the probability that an individual belongs to the quintile 1 or 2. “BCG” indicates the probability that a child under five were vaccinated against BCG. “Orphan” indicates the probability that a child is an orphan

<sup>†</sup> p < .1; \* p < .05; \*\* p < .01; \*\*\* p < .001

consultations during the women’s most recent pregnancy. From 1998 to 2011, unlike in areas not affected by the conflict, the average number of prenatal visits decreased in affected areas by 0.75. With the slight increase of 0.09 in non-affected areas, this suggests a reduction of the number of prenatal visits by 0.84 during the conflict. The data also suggest that vaccination of children was affected by conflict. The proportion of children under five who received their first vaccine (BCG) decreased in conflict areas from 0.87 to 0.80. In areas not affected by the conflict, this proportion increased from 0.71 to 0.74, suggesting an overall decrease of 10 % in BCG vaccinations during the conflict. Regressions 3 and 4 in Table 8 confirm the decrease in immunization of children under five against BCG. Indeed, children under five from 2011 to 2012 DHS survey (so exposed to the period of the conflict) and living in conflict-affected area experienced a decline of at least 10 % immunization against BCG.

*Other Mechanisms*

According to Honwana (2006), children are often used as soldiers in conflicts. This use of children as soldiers can also drive the negative effect on schooling. Since this phenomenon typically pertains to boys, the gender difference in the impact of the conflict can be used to check whether this phenomenon occurred in the case of Ivory Coast. Previous sections did not indicate a gender difference in the impact of the conflict on school enrolment or school attainment. This suggests that the decrease in schooling rate was not driven by the use of children as soldiers during the conflict.

Parental Involvement affects childhood behavioral outcomes (Neymotin 2014; Stacer and Perrucci 2013). Comparing the proportion of orphans from the 2011–2012 survey between affected and non-affected areas, we notice

that 14 % of children 6–16 years old were orphans in conflict-affected areas compared to 12 % in unaffected areas.<sup>12</sup> Regression 5 in Table 8 shows the correlation between living in conflict-affected and the probability of being orphaned for children under 18 years old. This regress confirmed a positive correlation between living in conflict-affected area and being orphaned. This is another factor which could contribute to a lower school enrolment and school attainment rate in conflict-affected areas.

**Robustness Check: Migration**

The results presented so far could be biased by selective migration and so, not accurately capture the true causal effects of the conflict. For example, due to the conflict, if families with healthier children or families wishing to continue the education of their children migrated from conflict to non-conflict areas, my results would overestimate the impact of the conflict. On the other hand, if children from poorer families or from families with a low propensity of children’s schooling fled the conflict and moved from conflict to non-conflict areas, my results would underestimate the impact of the conflict. This section examines this probable selection issue and presented evidence that the main results are unlikely to be influenced by migration. To do so, Eq. 2 is estimated for school enrolment and school attainment restricted to individuals at least 35 years old in both pre and post conflict datasets. Individuals at least 35 years old in 2011 were likely to have children and thus move to non conflict areas for better conditions for their children.<sup>13</sup> By comparing pre and post

<sup>12</sup> Results not included here, as the 1998–1999 survey does not contain information on parental survival.

<sup>13</sup> Results do not change if individuals aged at least 25 or 30 years old are considered.

**Table 9** Impact by type of place of residency *Source* 1998–1999 and 2011–2012 Ivory Coast Demographic and Health surveys

	Urban		Rural	
	School enrolment	School attainment	School enrolment	School attainment
Conflict areas and post-conflict	–0.14*** [0.04]	–2.42*** [0.72]	–0.08** [0.03]	–0.60 [0.49]
Child's age fixed effects	Yes	Yes	Yes	Yes
Region fixed effects	Yes	Yes	Yes	Yes
Region-specific trends	No	Yes	Yes	Yes
Child and families characteristics	No	No	Yes	Yes
Observations	9390	7261	10,572	4014

Robust standard errors in brackets

Conflict area and Post-conflict indicates a child living in an area affected by the conflict and who was exposed to the conflict period depending to the outcome

\*  $p < .05$ ; \*\*  $p < .01$ ; \*\*\*  $p < .001$

conflict differences in the level of education for individual aged at least 35 years in conflict-affected areas to the pre and post conflict difference in unaffected areas, we notice that the difference of the level of adult education between conflict and non-conflict areas did not changed after the conflict.<sup>14</sup> This means that it was unlikely that parents with high or low educational levels moved to non-conflict areas during the conflict.

### Robustness Check: Distinguishing Urban and Rural Areas

The most affected areas are urban areas. So, how can we then distinguish, in the difference in differences approach used, the impact of conflict from a story of developing rural areas catching up to stagnant urban areas?<sup>15</sup> This could be a concern about the potential endogeneity of the conflict. This section attempts to deal with this potential endogeneity of the conflict by distinguishing urban and rural areas. Table 9 shows the impact of the conflict on schooling by the type of place of residency. The results are in line with the fact that urban areas are most affected by the conflict. Indeed, for school enrolment and school attainment (for which the number of observations allows to distinguish urban and rural areas) the impact of the conflict was higher in the urban areas. This difference was more severe for school attainment. This fact could be explained by the fact that the effect of the conflict on school enrolment would be temporary. Children may be enrolled in school when conflict events become comparatively rare.

<sup>14</sup> Results not presented here but can be obtained upon request.

<sup>15</sup> I would like to thank an anonymous reviewer for this remark and suggestion.

### Robustness Check: Distinguishing More and Less Affected Areas

The intensity of conflict varied widely across the country. Some regions were more affected than others in terms of occurrence of armed attacks. Following the definition in Fig. 1, areas more affected are those with at least five conflict events. They are represented in dark shading in Fig. 1, while, the less affected areas are represented in gray shading. Taking into account this heterogeneity, Eq. 2 can be rewritten as:

$$Y_{ijt} = \alpha_j + \sigma_t + \gamma_{jt} + \beta_{21}(\text{Conflict}_{1j} * \text{Post}_t) + \beta_{22}(\text{Conflict}_{2j} * \text{Post}_t) + \lambda X_i + \varepsilon_{ijt} \quad (3)$$

Where  $\text{Conflict}_{1j}$  and  $\text{Conflict}_{2j}$  are dummy variables indicating whether an individual lived in a more or less affected area respectively. In terms of magnitude, for each outcome,  $\beta_{21}$  is expected to be greater than  $\beta_{22}$  (in absolute values).

Table 10 presents estimation results of Eq. 3. The difference between more and less affected areas was not significant for children's education. However, in the more affected areas the magnitude of the conflict impact was greater compared to the less affected areas. According to child mortality, the impact of the conflict was mostly driven by children who lived in the more affected areas.

### Robustness Check: Using 2011–2012 Survey Only

Using 2011–2012 survey only, the exposure to the conflict can be defined with individual's age at the beginning of the conflict (1999). Since the official age to be enrolled in school was six, each child less than 7 years old at the beginning of the conflict was exposed to the conflict regarding school enrolment. Children at least 7 years old were not officially concerned by school enrolment. If a



**Table 10** Impact by intensity of the conflict *Source* 1998–1999 and 2011–2012 Ivory Coast Demographic and Health surveys

	School enrolment (6–18 years)	School attainment (6–24 years in school)	School attainment (12–24 years in school)	Child’s mortality (0–4 years)
Most affected conflict area and post-conflict	−0.104*** [0.023]	−1.300** [0.421]	−1.982** [0.611]	0.037* [0.018]
Less affected conflict area and post-conflict	−0.095*** [0.026]	−1.033* [0.495]	−1.689* [0.696]	0.030 [0.021]
Child’s age fixed effects	Yes	Yes	Yes	Yes
Region fixed effects	Yes	Yes	Yes	Yes
Region-specific trends	Yes	Yes	Yes	Yes
Families characteristics	Yes	No	No	Yes
Observations	19,962	11,275	6977	17,732

Robust standard errors in brackets

“Most affected area and Post-conflict” indicates a child living in most affected area and who was exposed to the conflict period depending to the outcome. “Less affected area and Post-conflict” indicates a child living in less affected area and who was exposed to the conflict period depending to the outcome

\*  $p < .05$ ; \*\*  $p < .01$ ; \*\*\*  $p < .001$

**Table 11** Impact of the conflict on school enrolment using 2011–2012 survey only *Source* 2011–2012 Ivory Coast Demographic and Health surveys

	School enrolment	
	[1]	[2]
Conflict area and post-conflict	−0.10** [0.03]	−0.06* [0.03]
Child’s age fixed effects	Yes	Yes
Region fixed effects	Yes	Yes
Child and families characteristics	Yes	Yes
Household fixed effect	No	Yes
Observations	17,898	

Robust standard errors in brackets

“Conflict area and Post-conflict” indicates a child living in a conflict-affected area who were less than 7 years in 1999 (beginning of the conflict)

\*  $p < .05$ ; \*\*  $p < .01$ ; \*\*\*  $p < .001$

child was not enrolled in school after his/her seventh year, this child was supposed to no longer be enrolled in school.<sup>16</sup> Doing so, the identification strategy in Eq. 2 is to compare in both conflict affected and non-affected areas the 2011 school enrolment rate of children less than 7 years at the beginning of the conflict to those aged 7 years or more. The upper bound is limited to 14 years old. Table 11 shows the results of the regression of Eq. 2 using this new definition of conflict-exposure. Without controlling by household fixed effect the results suggest a decrease of

<sup>16</sup> A sensibility test by changing the threshold from six to seven, six to eight and six to nine was made and the results did not change qualitatively.

school enrolment by 10 %. Adding household fixed effect to compare sibling before and after the conflict, the coefficient falls to 0.6 but stays significant.

**Robustness Check: Placebo Test**

Because political instability in Ivory Coast began in December 1999, using the 1994 and 1998–1999 DHS data allows to perform a placebo test. The data collection process is similar for the three DHS datasets. Therefore, if there are no pre-existing differences in children’s outcomes between conflict and non-conflict areas, using Eq. 2 with 1994 and 1998–1998 DHS data should lead to a non-significant coefficient of  $\beta_2$ , which would then confirm that the results obtained above are driven by the conflict. Following the definition of exposure to the conflict viewed previously, for each outcome, a placebo exposure to the conflict period was defined. For school enrolment, the subset of individuals from 6 to 18 years old in 1998 is considered as those exposed to the conflict period (post-conflict group). These individuals come from the 1998–1999 survey. Individuals of the same age from the 1994 survey are likewise considered the unexposed group (pre-conflict group). For school attainment, from the 1998–1999 survey, individuals from 18 to 36 years old in 1998 and who were enrolled in school are considered individuals exposed to the period of the conflict (post-conflict group). The subset of individuals from 18 to 36 years in 1994 (from the 1994 survey) is the pre-conflict group. Similarly, for children’s mortality, the post-conflict group is a subset of children from 5 to 16 years old in 1998, dead or alive (from the 1998–1999 survey), while the pre-conflict group is a subset of children in the same age range

**Table 12** Placebo test *Source* 1994 and 1998–1999 Ivory Coast Demographic and Health surveys

	School enrolment (6–18 years)	School attainment (6–24 years in school)	School attainment (12–24 years in school)	Child's mortality (0–4 years)
Conflict area and post-conflict	0.008 [0.022]	0.169 [0.842]	0.351 [1.466]	–0.005 [0.019]
Child's age fixed effects	Yes	Yes	Yes	Yes
Region fixed effects	Yes	Yes	Yes	Yes
Region-specific trends	Yes	Yes	Yes	Yes
Families' characteristics	Yes	No	No	Yes
Observations	17,809	8084	4584	17,321

Robust standard errors in brackets

“Conflict area and Post-conflict” indicates a child living in conflict affected area and who was exposed to the conflict period depending to the outcome

from the 1994 survey. To perform the test, the conflict-affected areas were also considered as placebo-conflict areas.

Table 12 presents the test results using these data. As we can see, in all cases, the coefficient of the interaction between exposure to conflict and residence in a conflict area is not significant. The results indicate that individuals who lived in placebo-conflict areas and exposed to the conflict period, according to the placebo-exposure definition, did not experience either lower school enrolment or less school attainment or more mortality. The placebo test suggests that the increase in children's mortality, and the decrease in school enrolment and school attainment, were not driven by preexisting differences across conflict and non-conflict areas.

## Discussion

The empirical strategy is based on the difference-in-difference approach, combining the temporal and geographical variation of the conflict to identify its causal effect on children's schooling and children's mortality. The strength of the difference-in-difference strategy lies in the combination of regional and time-varying exposure to the conflict. The results suggest that the political instability between 1999 and 2011 in Ivory Coast had adverse effects on school enrolment, school attainment, and children's mortality.

The exposure to the conflict for school enrolment takes into account the official age for being enrolled in school. Therefore, all individuals who reached their sixth birthday during the conflict period were exposed to the conflict. According to this definition, the subset of individuals from 6 to 18 years old in 2011 were exposed. Among them, those who lived in conflict areas had a 10 % lower

likelihood of being enrolled in school. School enrolment is a specific event that takes place in a defined period each year, generally between August and October. The intensity of the conflict was not uniform throughout the conflict, so, if some children were not enrolled in school in a given year due to the occurrence of conflict events, they could be enrolled in succeeding years if there were a lull in the fighting. The impact of the conflict on school enrolment would be higher in the short term, especially in the period following conflict events. Children may be enrolled in school when conflict events become comparatively rare. Similar results were found by Shemyakina (2011) for Tajikistan's 1992–1998 armed conflict. Indeed, her results indicated that in 1999, girls from 7 to 15 years of age were about 11 % significantly less likely to be enrolled in school if their households' dwelling was damaged during the war. In absolute terms, this adverse effect includes many children who need specific treatment. After the conflict, while younger children aged 6–8 could be enrolled in school, older children were less likely to still attend formal schooling. Therefore, the development and implementation of specific programs such as vocational and technical training becomes essential for them.

It is generally recognized that education is a powerful driver of development and one of the strongest instruments for reducing poverty and improving health. To consider education as an engine of development, requires a minimum level of education. According to UNESCO (2012), formal secondary schooling is the most effective way to develop the skills needed to improved personal development. To identify the causal effect of Ivorian conflict on school attainment, the subset of individuals aged 6–24 at the beginning of the conflict was considered the exposed group. This group corresponds to school-age people, including the post-secondary level. The results showed that students exposed to the conflict who lived in conflict areas

experienced more than a one year drop in average years of schooling. Older students, especially those who were supposed to be at high school at the beginning of the conflict (at least 12 years old in 1999), were the most acutely affected, with almost a two year drop. The regressions results can be viewed as a permanent effect of the conflict on education, because students aged 6–24 years in 1999 were 18–36 years old in 2011.

The last dependent variable used in my estimation is children's mortality. The results indicated that children who spent at least one year in the period of the conflict had at least a 3 % greater chance of dying before reaching age five. Because of younger children's fragility, armed conflict can indirectly affect children's health through the deterioration of family resources. Limiting access to health care services during the conflict directly affects children's health. In the Ivorian conflict, the decrease in children's vaccination rate and the deterioration of families' living condition might have contributed to the increase in children's mortality.

However, some limitations of this study must be noted. First, the data used in this study might suffer from selection bias due to the potential non-coverage of internally-displaced individuals, who were likely most affected by the conflict. Therefore, the results might underestimate the impact of the conflict. Moreover, the data do not include information on individuals who died during the conflict. If these individuals were less likely to be enrolled in school or more likely to leave school early, the results on schooling would be underestimated. The results on children's mortality might also be underestimated if among individuals who died, they were under 5 years old. In other words, the results only apply to individuals who stayed in the country after the conflict. The second limitation of this study is considering actual residence as the residence in which events occurred. The estimation strategy assumes that individuals have not migrated since the beginning of the conflict. So, selective migration of individuals affected by the conflict might bias the results. Individuals' current location might differ from the ones where conflict events occurred. If enough households affected by the conflict moved to non-affected areas, then the estimated results underestimate the current impact of the conflict. Unfortunately, data used in this study do not contain information on individuals' migration history. Therefore, the estimates should be considered the lower bound of the true parameters. Finally, data on children's mortality concern only women from 15 to 49 years old, which could lead to selection bias. However, women over 49 years old and under 15 years old are substantially less likely to have children, so one can assume that this bias is not an important concern.

## Conclusion

This paper investigates the impact of the 1999–2011 Ivorian political instability on schooling and children's mortality by comparing the differences between affected and non-affected individuals in children's schooling and children's mortality for exposed cohorts identified in one nationally representative cross-sectional survey conducted prior to the beginning of the instability (in 1998–1999), with the difference between those affected and non-affected for unexposed cohorts in another nationally representative cross-sectional survey conducted at the end of the conflict (in 2011–2012). The two surveys used the same methodology for data collection. Therefore, the empirical identification strategy used both pre-conflict and post-conflict data to exploit geographical variation of the conflict.

The results showed that Ivorian political instability caused a decrease in schooling and an increase in mortality for children under 5 years of age. Individuals who lived in conflict areas and who reached the official age for being enrolled in school within the period of the instability had a 10 % lower chance of being enrolled in school. Students exposed to the conflict during their school-age years and who lived in an affected area experienced a decline in schooling attainment of more than one year (1.14). Older students or those who were likely to be in high school at the outset experienced a decline in schooling attainment of close to 2 years (1.81). With respect to children's mortality, the results showed that Ivorian armed conflict increased under-five children's mortality by 3 %.

To confirm that these results can be attributed to the conflict rather than other events occurring between 1999 and 2011, a placebo test using another pre-conflict dataset was performed. These data were collected in 1994 using the same methodology as the other data. To perform the test, the previous empirical strategy was applied to the two pre-conflict datasets by defining placebo-conflict areas and placebo-exposure to the conflict. The test results confirm that the adverse effects of the conflict were not driven by pre-existing differences across conflict and non-conflict areas. The degradation of family living conditions and the limitations on the use of health services during the conflict might explain these adverse effects.

Education is seen as an important component of human capital. By promoting adoption of new modes of behaviour in terms of human reproduction and health life management, and improving education, is seen as an engine of economic growth. Ivorian armed conflict by affecting children's education and child mortality could hamper the long-term economic development of the country. The

reduction in school attainment might have negative welfare consequences by reducing future adult wages and productivity. The development and implementation of specific programs such as vocational and technical training are essential to mitigate this impact, especially for the older students for whom the likelihood of returning to school is low. Family living conditions appear to be a channel associated with the increase of school dropout and child mortality rates in the case of Ivory Coast. It is, therefore, essential to promote interventions targeting conflict affected areas to restore economic well-being. This study also confirms the need for special protection of children during conflicts.

However, my research also shows that the socioeconomic costs of political instability are likely to be underestimated because of the unavailability of migration history. Future research could use variation in residency to define exposure to the conflict more fully and accurately and therefore identify conflict impacts better.

#### Compliance with Ethical Standards

**Conflicts of interest** The author declares that they have no conflict of interest.

**Informed Consent** Informed consent was obtained from all individual participants included in the study.

**Research Involving Human and Animal Rights** All procedures performed in studies involving human PARTICIPANTS were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. This article does not contain any studies with animals performed by any of the authors.

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