DISCUSSION PAPER SERIES

IZA DP No. 7539

Surviving the Genocide: The Impact of the Rwandan Genocide on Child Mortality

Federico Ciani
Gianna Claudia Giannelli

July 2013

Forschungsinstitut
zur Zukunft der Arbeit
Institute for the Study
of Labor

Surviving the Genocide: The Impact of the Rwandan Genocide on Child Mortality

Federico Ciani
University of Florence

Gianna Claudia Giannelli
University of Florence
and IZA

Discussion Paper No. 7539
July 2013

IZA

P.O. Box 7240
53072 Bonn
Germany

Phone: +49-228-3894-0
Fax: +49-228-3894-180
E-mail: iza@iza.org

IZA Discussion Paper No. 7539
July 2013

ABSTRACT

Surviving the Genocide: The Impact of the Rwandan Genocide on Child Mortality*

Between April and July 1994 Rwanda experienced a tremendous wave of inter-ethnic violence that caused at least 500,000 deaths. Combining birth history data drawn from the 2000 Rwanda Demographic and Health Survey with prefecture-level information on the intensity of the conflict, we examine the impact of the civil war on infant and child mortality. War exposure is measured exploiting the differential effects of timing of birth and genocide intensity at the household and geographic level. Considering both *in utero* and postnatal war exposure, we estimate discrete time proportional hazard models of child mortality for the exposed and the unexposed birth cohorts. We find large positive effects of exposure to the conflict on infant and child mortality. Moreover, restricting our sample to the survivors, we find that child mortality is significantly impacted by war exposure, increasing the hazard rate by nearly 6 percentage points on average. This result holds true also for children who were only exposed while *in utero*. This evidence points to the existence of long-term disruptive effects on the cohorts of children exposed to the violence.

JEL Classification: I20, J13, O12, Z13

Keywords: genocide, child mortality, child health, survival analysis, Rwanda

Corresponding author:

Gianna Claudia Giannelli
University of Florence
Department of Economics and Management
Via delle Pandette 9
50127 Florence
Italy
E-mail: giannelli@unifi.it

* In 2014, the 20th anniversary of the Rwandan genocide will be celebrated. We think this piece of research could contribute to increase the knowledge of the consequences of such inhuman tragedies.

I. Introduction

This paper investigates the effects of a war on child mortality. The study of the consequences of wars for children is part of a more general field of research which aims at establishing a causality nexus between early living conditions and outcomes later in life. Negative shocks affecting newly born children's health may lead to lower height, less cognitive achievement, slower human capital accumulation, lower productivity and wages as adults, particularly in low income countries (Strauss and Thomas 1998). Exploiting the temporal and geographic variation of exogenous shocks, some recent papers provide evidence of causal links between, for example, crop failure (Banerjee 2010 et al.), famine (Meng and Qian 2009), and rainfall (Maccini and Yang 2009), with children's outcomes later in life. Negative shocks exclusively experienced while *in utero* have also been proven to affect children's health (Stein 1975; Almond 2006).

Turning to the focus of this paper, some studies have analyzed the impact of war on children's outcomes several years after the end of a conflict. As far as health and human capital are concerned, some studies find a negative impact of wars on children's height for age z-scores, while others on children's schooling. Bundervoet et al. (2009), for example, finds that an additional month of war exposure decreases children's height for age z-scores by 0.047 standard deviations compared to non-exposed children in Burundi. Akresh et al. (2011) shows that in poor and non-poor households in Rwanda, boys and girls born during the conflict in regions experiencing fighting are negatively impacted with height for age z-scores 1.05 standard deviations lower. Akresh et al. (2012) finds that individuals exposed to the Nigerian civil war of 1967-70 at all ages between birth and adolescence exhibit reduced adult stature and these impacts are largest in adolescence.

As far as schooling is concerned, Akresh and De Walque (2010), for example, finds a strong negative impact of Rwanda's genocide on children's schooling, with exposed children completing half a year less education, which amounts to an 18.3 per cent decline in school completion. Shemyakina (2011) finds that exposure to violent conflict has a large and statistically significant negative effect on the enrolment of girls (not of boys) in Tajikistan. León (2012) finds that in Peru exposure to violence reduces adult education by 0.31 years , and in the short term the effects are stronger than in the long run.

Surprisingly enough, although child mortality is of interest to economists for many reasons (Currie, 2008), in this growing body of literature little attention has been paid to the survival of children exposed to a conflict. In this paper we address the issue of whether a war, beyond its immediate consequences on mortality rates, may continue to generate disruptive effects on child health and mortality, for a long time after its conclusion. In other words, we ask whether a war may leave behind a "permanently fragile" generation composed by the children who have been exposed to it.

A positive answer to this question has relevant policy implications, since aid intervention, in such case, should not only face the war and its direct post-war consequences, but also plan middle-term targeted actions to support the fragile generation.

We study the case of Rwanda. Using the birth history data drawn from the 2000 Rwandan Demographic and Health Survey (RDHS 2001), we investigate the impact of the 1994 Rwandan genocide on mortality of the cohorts of children who were exposed to it, both *in utero* and in life, as compared to children who were not exposed to it. From a methodological point of view, the Rwandan case is particularly suitable for such analysis for two reasons. Firstly, the fast recovery of the population - dramatically reduced by the war - to its initial dimension, might induce to suppose that the war, after all, did not generate any lasting consequences. We question this supposition. Secondly, the bulk of the conflict related violence was extremely concentrated in time (four months), so that the macroeconomic background is likely to have remained the same for both the exposed and the unexposed children, thus reducing the problem of controlling for changing economic conditions.

We focus both on infant mortality (mortality in the first year of life) and on child mortality(mortality in the first five years of life). Exploiting temporal and spatial variation, we devise a battery of indicators to capture exposure to the genocide, and use them alternatively. We proxy exposure either with a dummy taking value one if a child was alive (or *in utero*) at the time of the genocide, or with the variable "length of exposure in months". Using information on the geographic intensity of the genocide contained in Justino and Verwimp (2008), a child's residence is classified to be in a prefecture with "very intense", "moderately intense" and "not intense genocide". Finally, genocide intensity is measured at a household level with the ratio of deaths among maternal siblings in 1994.

We estimate several specifications of discrete-time survival models with piecewise constant baseline hazards, comparing the hazard ratios of the group of children exposed to the genocide with those of children unexposed to it. In order to disentangle the long-run effects of the war, we estimate separate models for children who were exposed and might have died during the conflict, and children who survived it. To test the assumption of whether pre-natal exposure might lead to increased child mortality, we also estimate the model for the subsample of children who were only exposed while *in utero*.

We find large positive effects of exposure to the conflict on infant and child mortality. Moreover, restricting our sample to the survivors, we find that child mortality is significantly impacted by war exposure, a result that shows that the effects of the conflict last several years after the end of the war.

The paper is structured as follows. Section II briefly introduces the Rwandan genocide. Section III describes the data end the econometric method used. Section IV presents the estimation strategy. Section V discusses the results of the survival analysis and Section VI concludes with some implications for policy.

II. The Rwandan Genocide

The African Great Lakes region has been disrupted by civil and inter-state wars, genocides and coups d'état since the mid-nineties. Only nowadays it is possible to glimpse a feasible path of stabilization of the region even if armed conflicts are still standing (for example in the Kivu region in the Democratic Republic of Congo) and many states in the region are still fragile. In this context, Rwanda played a crucial role: despite its small dimension, Rwanda contributed to destabilize the whole region. In 1994, Rwanda experienced a genocide whose inhuman fierceness can be found in very few other circumstances in human history: in only 100 days (in the period ranging from April to July 1994) between 500,000 and 800,000[1] Tutsi and moderate Hutu[2] were killed by the Rwandan army, by the police and by the members of the Interhamwe militia.[3] As yet, there is no consensus about the estimated number of deaths, but the total number, including those indirectly due to the genocide (for example deaths occurred among displaced people), ranges from 800.000 (UN) to one million (Rwandan Government). Despite this sudden and tremendous population loss, Rwanda quickly went back to the pre-genocide path of demographic growth (see Figure 1). This recovery, however, doesn't exclude the existence of long term negative consequences of the genocide for the Rwandan population.

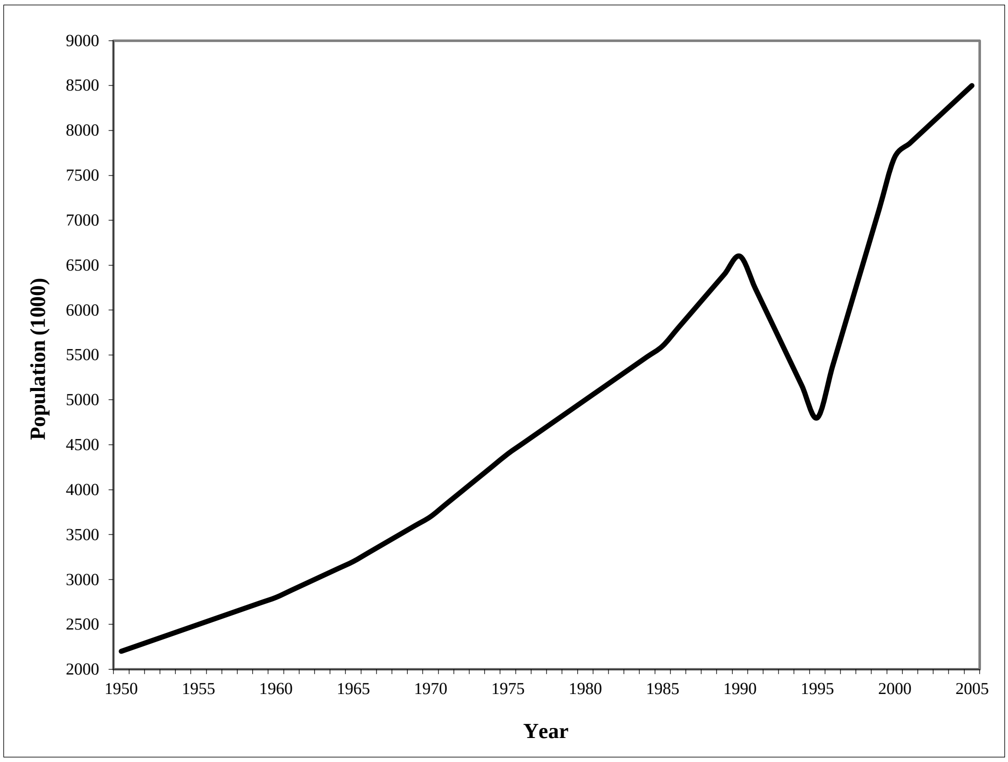

Figure 1. *Trend of Rwandan Population (1950-2005)*
Source: World Population Prospects: The 2008 Revision (UN Population Division, 2008) as reported in Hong et al. (2009)

[1] These estimates are provided in the report "Rwanda: the Preventable Genocide" (OAU, 1999).
[2] Hutus that were not supporters of the "Hutu power" ideology.
[3] Detailed data and information concerning Rwandan genocide are available on the website www.genodynamics.com.

The Rwandan genocide results from the combination of exogenous and endogenous factors. Newbury (1998) observes that ethnic tensions are a constant of the Rwandan history and that they have been managed in various ways, including violence. Exogenous factors (chiefly the Belgian colonization and the Belgian "indirect rule" system) have induced a calcification of ethnic identities and consequently reduced the number of viable solutions of ethnic tensions. Other authors stress the role played by economic factors such as the austerity measures imposed by the IMF and The World Bank (Chossudowsky 1996) and the sharp fall of the price of coffee (Verwimp, 2003).

The deaths directly due to violence of the genocide were not randomly distributed among the Rwandan population. In fact, there was a quite well defined targeting: the surplus mortality directly due to the genocide was particularly high among urbanized Tutsi[4] adult males, who were richer and more educated than the average of the population (De Walque and Verwimp, 2009). Since children were not an explicit target of the violence committed during the genocide, it becomes relevant to analyze the consequences of the events occurred between April and July 1994 for child mortality.

III. Data and Empirical Specification

Following the current definitions of child mortality (Van der Klaaw and Wang, 2011) we focus on "infant mortality" (child mortality in the first year of life) and on "child mortality" (child mortality in the first five years of life). We use the 2000 Rwandan Demographic and Health Survey (RDHS 2001)[5] which records each woman's "birth history" collecting recall information on each birth in her lifetime from January 1990 (the first available date of birth in the survey) to the time of the interview.[6] Also, RDHS collects information on several aspects of child health, such as anthropometrics, vaccination, prenatal and delivery assistance. However, this information is only

[4] It must be noticed that even if the mortality rate were higher among Tutsi, the most part of victims (in absolute numbers) probably were Hutu.
[5] RDHS 2000 is the first available survey after the genocide.
[6] The interviews took place between June 26 and November 30, 2000.

available for children who were born no later than five years before the interview (that is, at most in 1995). Unfortunately, since our focus is on children born around the period April-July 1994, we cannot investigate these aspects.

Information on children's month and year of birth - and also month and year of death in case of children who are not alive at the time of the interview - allows us studying child survival probability with monthly data. Given this data structure, we treat children's survival histories as formed by monthly intervals, and estimate a discrete time specification.[7] Measuring time in monthly intervals *j* indexed by the positive integers, we choose a complementary log log functional form (Jenkins 1995) [8] to model the *jth* hazard rate for each child's survival up to month *j* as follows :

$$h(j, X) = 1 - \exp[-\exp(\beta' X + \gamma_j)] \qquad (1)$$

where *h(j,X)* is the discrete time hazard function, *X* is a vector of household, maternal, and child characteristics. It also includes several variables approximating the exposure to civil war. γ_j is the baseline hazard for interval *j*.

Another crucial point is the specification of a functional form of the baseline hazard. We use a piecewise constant specification assuming, in the model for infant mortality, a constant baseline hazard for each month. For the child mortality model, we group months in each constant baseline hazard according to what is common knowledge about the timing of mortality (higher in the first months and in the first year than in the subsequent years). Under these assumptions, γ_j in (1) can be expressed as follows:

$$\gamma_j = \gamma_1 D_1 + \gamma_2 D_2 ... + \gamma_T D_T \qquad (2)$$

[7] To estimate the model we need to transform the data in person-periods, that means having for each child in the data matrix as many rows as the months at risk.

[8] The *cloglog* model is the discrete time representation of a proportional hazards model.

where T is the number of interval groups and the Ds are the dummies for each group. Using a specification without the constant term, we end up with twelve monthly dummies in the infant mortality model and with four dummies for months 5 to 12, 13 to 36, 37 to 48 and 49 to 60 in the child mortality model. In each model we control for "frailty", that is, unobservable heterogeneity. Moreover, since DHS surveys have a stratified structure (individuals are nested into households, households into communities and communities into regions) we choose to compute clustered standard errors, allowing for intra-group correlation.

We estimate five model specifications. In the first two models we analyze the consequences of the genocide for infant mortality. In the third model we focus on the consequences for child mortality of having experienced the genocide in the first two years either *in utero* or in life. In the fourth model, we focus on child mortality of the survivors, namely children who were exposed to the genocide and could turn five before the date of the interview. Finally, in the fifth model, we restrict our sample to the children who were only exposed while *in utero.*

IV Estimation Strategy

A. Model 1: Infant Mortality

The first model tests whether the genocide is significantly associated with higher infant mortality. For this scope, we select the cohorts of children born between May 1993 and July 1994, namely, children who have been exposed to the genocide during their first year of life. In order to test whether the genocide impacted children exposed to it while *in utero*, we also include in the sample children born between August 1994 and April 1995.[9] According to this sample selection rule, the sub-sample of "exposed" children is composed by 2889 children. We add to this sub-sample two cohorts of not exposed children. These two groups are chosen according to the same temporal

[9] As data concerning premature delivery are not available, we have imputed a standard length of pregnancies of 9 months.

definition: the first group includes children born during the year preceding the genocide, namely, between May 1991 and April 1993. The second group includes the cohort of children born during the year following the genocide, namely, between May 1995 and April 1997. These two sub-samples are formed by 2579 and 3271 children, respectively.[10] In Table 1, the observed children are distributed according to their group and to their month of birth. For each monthly cohort, the percentage of children who died during their first year of life is reported. The last row reports the total number of children and the total percentage of deaths for each group. It is easy to notice that the percentage of deaths among the exposed children is the highest while the percentage for the post-genocide group is the lowest. This evidence seems to suggest that the genocide might have induced a temporary deviation from a virtuous trend improvement of infant survival conditions.

Table 1

[10] Note that no survival spell at the child level is either left or right censored since, in order to have a balanced sample, we have sampled all children born up to two years before and up to two years after the genocide. Since the last post-genocide children in the sample were born in April 1997 and the interview period ranged from June 26th to November 30th of year 2000, all sampled children had the opportunity to survive one year.

Table 1

Infant Mortality by Monthly Birth Cohort (Exposed Children and Unexposed Children)

Pre-genocide group			Exposed group			Post-genocide group		
Month of birth	No. of obs.	Deaths 1st year of life (%)	Month of birth	No. of obs.	Deaths 1st year of life (%)	Month of birth	No. of obs.	Deaths 1st year of life (%)
May 91	143	15.38	May 93	125	14.40	May 95	126	11.11
June 91	132	11.36	June 93	115	11.30	June 95	129	6.20
July 91	136	15.44	July 93	143	14.69	July 95	154	10.39
Aug. 91	106	12.26	Aug. 93	111	14.41	Aug. 95	156	5.77
Sept. 91	85	7.06	Sept. 93	97	15.46	Sept. 95	144	9.03
Oct. 91	63	19.05	Oct. 93	97	15.46	Oct. 95	116	11.21
Nov. 91	95	8.42	Nov. 93	76	25.00	Nov. 95	112	10.71
Dec. 91	87	17.24	Dec. 93	87	11.49	Dec. 95	104	9.62
Jan. 92	159	14.47	Jan. 94	113	15.93	Jan. 96	165	4.24
Feb. 92	135	8.15	Feb. 94	157	14.01	Feb. 96	126	12.70
Mar. 92	136	11.76	Mar. 94	138	10.87	Mar. 96	120	10.00
Apr. 92	129	12.40	Apr. 94	232	17.67	Apr. 96	150	10.00
May 92	155	12.90	May 94	151	14.57	May 96	156	8.97
June 92	107	10.28	June 94	164	19.51	June 96	171	12.28
July 92	122	17.21	July 94	194	12.37	July 96	173	10.40
Aug. 92	130	9.23	Aug. 94	159	14.47	Aug. 96	136	7.35
Sept. 92	64	20.31	Sept. 94	129	13.95	Sept. 96	129	6.98
Oct. 92	61	6.56	Oct. 94	116	12.93	Oct. 96	120	15.00
Nov. 92	69	7.25	Nov. 94	77	24.68	Nov. 96	126	9.52
Dec. 92	85	5.88	Dec. 94	87	20.69	Dec. 96	116	12.07
Jan. 93	101	10.89	Jan. 95	83	7.23	Jan. 97	123	8.13
Feb. 93	115	4.35	Feb. 95	72	11.11	Feb. 97	133	12.78
Mar. 93	97	14.43	Mar. 95	69	13.04	Mar. 97	124	4.03
Apr. 93	67	16.42	Apr. 95	97	14.43	Apr. 97	162	14.20
Total	2579	12.02	Total	2889	14.91	Total	3271	9.66

B. Model 2 : Infant Mortality of Children Exposed to the Genocide

In the second model we try to deepen some aspects of the exposure to violence. Consequently the sample is restricted to the 2889 children who experienced postnatal and *in utero* exposure to the genocide. Table 2 reports more detailed information concerning the generations of children exposed to the genocide.

Table 2

Structure of Exposure to the Genocide and Infant Mortality by Monthly Birth Cohort (Only Exposed Children)

Month of birth	No obs.	% deaths during the 1st year of life
Apr. 95	125	9.62
Mar. 95	115	14.10
Feb. 95	143	12.50
Jan. 95	111	12.70
Dec. 94	97	20.78
Nov. 94	97	25.00
Oct. 94	76	12.37
Sep. 94	87	14.91
Aug. 94	113	13.74
July 94	157	11.88
June 94	138	21.83
May 94	232	12.40
Apr. 94	151	17.44
Mar. 94	164	10.74
Feb. 94	194	12.78
Jan. 94	159	15.53
Dec. 93	129	11.11
Nov. 93	116	22.58
Oct. 93	77	14.77
Sep. 93	87	16.47
Aug. 93	83	13.59
Jul. 93	72	13.08
June 93	69	9.00
May 93	97	15.18
Total	2889	

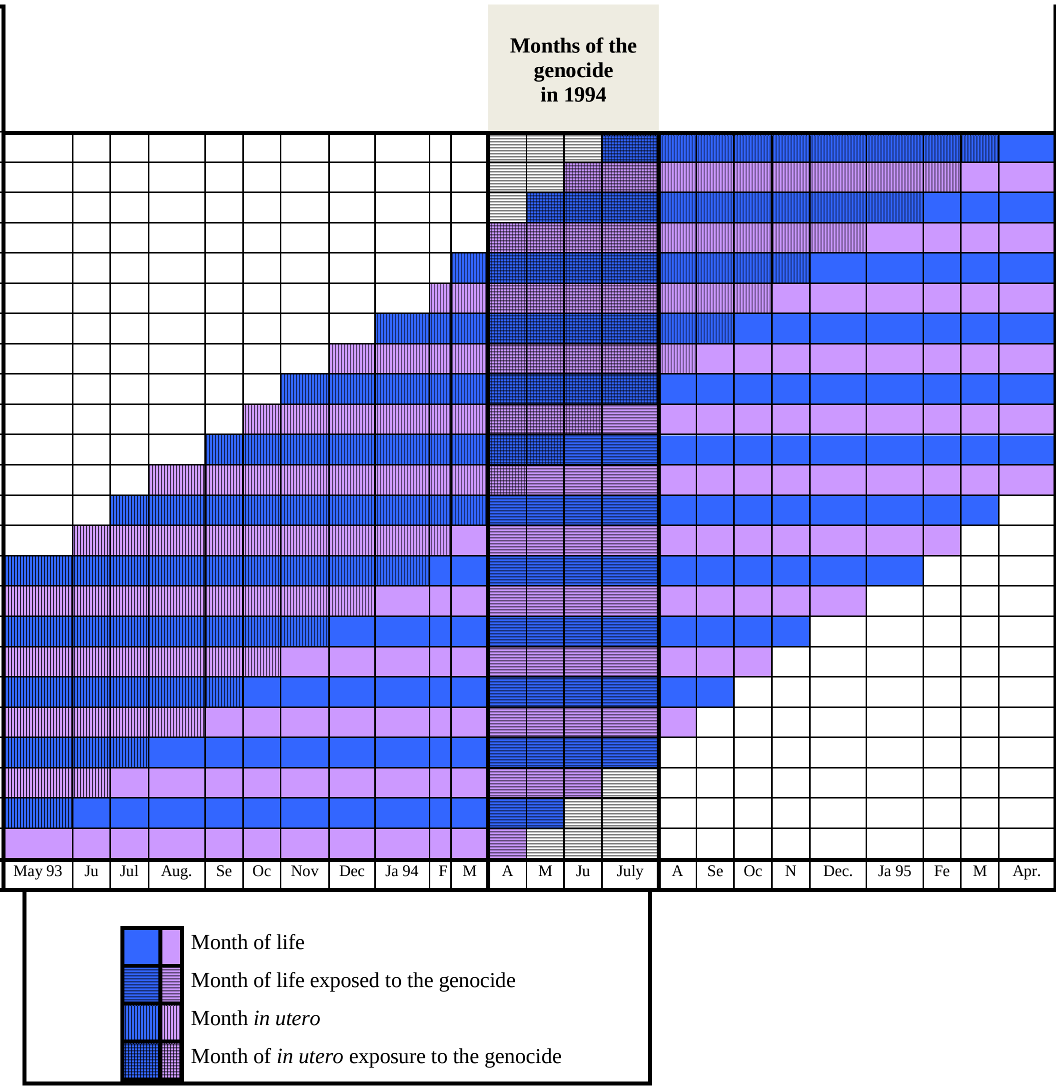

Table 2 shows the structure of exposure to the genocide for each monthly cohort of children distinguishing between postnatal and *in utero* exposure. For example, the 138 children born in June

1994 were directly exposed to the genocide for two months and while *in utero* for another two months.

C. Model 3: Child Mortality

The third model aims at investigating the consequences of the genocide for survival until the age of five. In this case, our dependent variable is the probability of dying between the first and the sixtieth month of life. The sample includes all children who, given their birth date and their mothers' month of interview in 2000, may turn five before or at the date of the interview. Cohort exposure is defined here as having lived at least one month of the first two years in life or *in utero* during the genocide. According to this sample selection rule, dates of births range from January 1990 to December 1995.The threshold of two years has been chosen since evidence on malnutrition shows that the most critical period for children in terms of nutritional benefit is the first two years of their life, and that damage caused by under-nutrition in in this period of life is irreversible (Black et. al. 2008). With this definition of exposure, the sample consists of 7974 children.

D. Model 4: Child Mortality of Children who Survived the Genocide or Were Born After It

The aim of Model 4 is to identify the impact of the genocide on child mortality of children who survived it. We select all children born after March 1994, who survived the first four months of life (the duration of the war).[11] Moreover, we drop children who were not potentially able to turn five before the month of interview in 2000 – whether alive or not at the time of the interview. This sample consists of 2099 individuals (both exposed and unexposed). In this model, we control for the length of the postnatal and *in utero* exposure to the genocide, which ranges from 0 to 4 months.

E. Model 5 Child Mortality of Children who Were Exposed While in Utero

[11] This sampling rule requires that children born in April 1994 survive for four months until the end of the war. For this reason, all children in this sample, both exposed and unexposed, must have survived for four months.

In order to test whether the mere pre-natal exposure has an effect on mortality, we also estimate the model on the subsample of children born after March 1994 who were just exposed while *in utero* plus the group of those who were conceived and born after the genocide, a sample amounting to 1442 children. As in the previous model, we control for the length in months of *in utero* exposure.

F. Genocide Variables

Exposure to the genocide, our variable of interest, is controlled for in different ways across our model specifications.

In Model 1 on infant mortality we introduce two dummies, *pre-genocide group* and *post-genocide group*. They are set equal to one if the child is born between May 1991-April 1993 and between May 1995-April 1997, with the cohort of children born between May 1993-April 1995, the *exposed group*, acting as baseline.[12] Moreover, some of the exposed children did not survive till the beginning of the genocide.

In Model 2 on infant mortality of the exposed children, two variables approximate the intensity of exposure exploiting the variation of the genocide at a household and geographic level: *ratio of deaths among maternal siblings* and *prefecture genocide intensity*. The first variable, drawn from a special section of RDHS (2001) on siblings' mortality data, is the ratio of the number of deaths in 1994 among siblings of women aged 15-49. This variable might be a good proxy of the level of violence or, more in general, of a stressful situation faced by the household during the genocide (De Walque and Verwimp 2009). The second one is a dummy variable constructed using the Justino and Verwimp (2008, Table 1b) classification of prefectures by genocide intensity into *prefectures with very intense genocide* (Butare, Cyangugu, Gikingoro and Kibuye), *prefectures with moderately intense genocide* (Gitarama, Kigali and Kibungo) and *prefectures with not intense genocide*

[12] Note that in this model with exposed and unexposed children we approximate exposure in no other way than with these dummy variables, so that it would be more precise to talk about "potential exposure" to the genocide.

(Byumba, Giseny and Ruhengeri). This proxy, which is built using the prefecture of residence of the household in 2000, captures exposure intensity only for households that either did not move from the prefecture after the genocide or returned afterwards. For households that have permanently changed residence after the genocide, this proxy does not have the intended meaning. This is a disadvantage, since displacement is another dramatic consequence of a conflict. However, it may be assumed that, in 2000, after five years since the end of the war, some of the displaced households might have returned to their homes.

As discussed, in Model 3 on child mortality, cohort exposure is defined as having lived at least one month of the first two years (plus the nine months *in utero*) during the genocide, and is specified with the dummy *cohort exposure in the first two years*. Since cohort exposure is only a proxy of "potential" child exposure to the genocide, in order to better approximate the effective exposure of the child's household, we interact this variable with the proxy of intensity of exposure at the household level, that is, we introduce the variable *cohort exposure in the first two years *ratio of deaths among maternal siblings*.

In Model 4 a more informative variable has been used to approximate the individual intensity of exposure to the genocide, *number of months of exposure*. It is a variable ranging from 0 to 4, indicating the number of months of exposure to the genocide both during the first year of life and *in utero*. The use of this variable in the other models would be misleading. In fact, since the first months of life are physiologically characterized by the highest probability of death, as months of exposure to the genocide increase, also the probability of child survival increases. This effect dominates the negative effect of the genocide, and the variable *number of months of exposure* is positively correlated with child survival. Since the analysis of Model 4 focuses on the survival after the fourth month of life, this problem does not arise. For the same reason explained for Model 3, we use the interaction *number of months of exposure *ratio of deaths among maternal siblings*.

G. Other Control Variables

As for the other control variables, we use the classic control variables for infant and child mortality such as birth spacing, mother's education, mother's age at birth, household wealth and so on (see, for example, Van der Klaauw and Wang 2011). We illustrate the most relevant ones.

Oral rehydration therapy is considered as a pivotal component of the struggle to reduce infant mortality, as it is an effective, cheap and easy to use mean to mitigate the effect of diarrhea and other gastro-enteric diseases (Victora et al. 2000). We include a dummy for mother's knowledge of oral rehydration therapy.

As one of the main sources of contamination is water, the presence in the household of an improved source of water is an important factor to improve child health.[13] A dummy variable indicating whether a household has access to an improved water source is included in the models.

In order to investigate the relationship between women's empowerment and child mortality, contraception is introduced in the model as a proxy of women's autonomy and emancipation (Eswaran 2002). A dummy variable equal to one if child's mother has ever used a modern contraceptive method is therefore included in the models. The association between mothers' education and children's health is one of the most investigated and verified relationships (see, for example, Mosley and Chen 1982), and we include a dummy for mother's literacy.[14] Mother's age at birth is another important aspect possibly related to child health. In fact, health and development may be different between children of teenage or very old mothers and normal age mothers (Rothenberg and Varga, 1981).[15] Mother's age at birth is included as a continuous variable with a quadratic specification.

[13] The definition of improved water source is taken from DHS (2008). According to this definition, public taps, protected private and public wells and piped water are considered improved water sources.

[14] The DHS survey includes variables describing the interviewed women's level of education. However, some incongruity in the data is to be noticed: 723 women (9.5% of total educated women) who declared to have reached at least the degree of primary education are, however, unable to read. We therefore prefer to use a dummy variable for literacy, as literacy is checked by the interviewer with a quick test.

[15] The authors find, for the US, that older maternal age has an adverse effect on a child's educational outcome regardless of whether other factors are controlled for or not. Instead, the association of young maternal age and long-term morbidity is not significant when controlling for other factors.

Birth spacing is very important for mothers' and children's health. Close births tend to put mothers' physical condition under pressure and children born in this condition tend to be more fragile (Winikoff 1983). A categorical variable concerning birth interval (with the class 1-23 months as reference category) has been introduced.

We control for sex of the child and sex of the household head including two gender dummies (equal to one if the child is male and if the household head is female).

The effect of wealth is caught by the scores of the wealth index computed according to the methodology described by Filmer and Pritchett (2001) and Rutstein (2008). Infant and child mortality are usually negatively correlated with the household wealth index.

Table 3 summarizes the characteristics of the estimated models.

Table 3

Summary of the Characteristics of the Estimated Complementary Log Log Models

	Estimated Models	Samples	Variables for exposure to the genocide
Model 1	Infant Mortality (1-12 months), exposed and unexposed cohorts.	Birth cohorts of children born between May 1991 and April 1997.	A dummy *pre-genocide group*: children born May 1991 to April 1993; a dummy *post-genocide group*: children born May 1995 to April 1997; *exposed group (baseline)*: children born May 1993 to April 1995. *In utero* exposure is accounted for.
Model 2	Infant Mortality (1-12 months), exposed cohorts.	Birth cohorts of children born between May 1993 and April 1995.	*Ratio of deaths among maternal siblings in 1994.* Two dummies for residence in *prefectures with very intense genocide* and *prefectures with moderately intense genocide* (baseline: *prefectures with not intense genocide*). *In utero* exposure is accounted for.
Model 3	Child mortality (1-60 months), exposed and unexposed cohorts.	Birth cohorts of children born from January 1990 onwards that could turn five before or at the date of the interview.	Two dummies for residence in *prefectures with very intense genocide* and *prefectures with moderately intense genocide* (baseline: *prefectures with not intense genocide*). Interaction: *cohort exposure in the first two years(dummy)* ratio of deaths among maternal siblings in 1994.* *In utero* exposure is accounted for.
Model 4	Child Mortality (4-60 months), survivors and post-genocide unexposed cohorts.	Birth cohorts of children born after March 1994, who have survived the genocide and could turn five before or at the date of the interview.	Two dummies for residence in *prefectures with very intense genocide* and *prefectures with moderately intense genocide* (baseline: *prefectures with not intense genocide*). Interaction: *number of months of exposure *ratio of deaths among maternal siblings in 1994.* *In utero* exposure is accounted for.
Model 5	Child Mortality (4-60 months), exposed while *in utero* and post-genocide unexposed cohorts.	Birth cohorts of children born after August 1994, who have survived the genocide and could turn five before or at the date of the interview.	Two dummies for residence in *prefectures with very intense genocide* and *prefectures with moderately intense genocide* (baseline: *prefectures with not intense genocide*). Interaction: *number of months of in utero exposure *ratio of deaths among maternal siblings in 1994.*

Table 4 reports the descriptive statistics for Model 1 and 2 and Table 5 the descriptive statistics for Model 3, 4 and 5.

Table 4

Descriptive Statistics for Infant Mortality (1-12 months)

	Total population		Pre-genocide		Exposed		Post-genocide	
Variables	Model 1				Model 2			
	mean	s.d	mean	s.d	mean	s.d	mean	s.d
Prefecture fixed effects								
Kigali (urban)	0.10	0.30	0.09	0.28	0.10	0.30	0.12	0.32
Kigali (rural)	0.09	0.29	0.09	0.29	0.09	0.29	0.10	0.30
Byumba	0.14	0.34	0.14	0.34	0.14	0.34	0.13	0.34
Butare	0.08	0.27	0.09	0.29	0.07	0.26	0.08	0.28
Cyangugu	0.08	0.28	0.08	0.27	0.09	0.28	0.08	0.28
Gikongoro	0.07	0.26	0.08	0.27	0.07	0.25	0.08	0.27
Gisenyi	0.07	0.26	0.07	0.25	0.08	0.26	0.07	0.25
Gita rama	0.08	0.27	0.08	0.27	0.07	0.26	0.08	0.27
Kibungo	0.09	0.28	0.09	0.29	0.09	0.28	0.09	0.28
Kibuye	0.09	0.29	0.10	0.30	0.10	0.30	0.09	0.28
Ruhengeri	0.10	0.30	0.11	0.31	0.11	0.32	0.09	0.28
Household characteristics								
Urban	0.18	0.39	0.17	0.37	0.18	0.38	0.20	0.40
Wealth index score	-0.08	0.91	-0.12	0.88	-0.10	0.87	-0.03	0.95
Access to improved water source	0.81	0.39	0.81	0.39	0.80	0.40	0.82	0.39
Household head is female	0.33	0.47	0.40	0.49	0.34	0.47	0.27	0.45
Maternal characteristics								
Mother knows oral rehydration	0.88	0.32	0.88	0.33	0.88	0.33	0.89	0.32
Mother used contraception at least once	0.27	0.45	0.26	0.44	0.27	0.45	0.28	0.45
Mother can read	0.58	0.49	0.53	0.50	0.57	0.50	0.63	0.48
Child characteristics								
Mother's age at birth	28.42	6.54	28.46	6.32	28.75	6.51	28.11	6.73
First-born	0.22	0.41	0.20	0.40	0.20	0.40	0.25	0.43
1-23 months since previous birth	0.26	0.44	0.28	0.45	0.27	0.44	0.23	0.42

24-35 months since previous birth	0.26	0.44	0.26	0.44	0.26	0.44	0.26	0.44
36 or more since previous birth	0.48	0.50	0.46	0.50	0.47	0.50	0.51	0.50
Male	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50
Exposure to genocide (Model 1)								
Pre-genocide group	0.30	0.46	1.00	0.00	0.00	0.00	0.00	0.00
Exposed group	0.33	0.47	0.00	0.00	1.00	0.00	0.00	0.00
Post-genocide group	0.37	0.48	0.00	0.00	0.00	0.00	1.00	0.00
Genocide intensity (Model 2)								
Ratio of deaths among mat. siblings 1994					0.11	0.21		
Prefectures with not intense genocide					0.32	0.47		
Prefectures with moderate intensity					0.35	0.48		
Prefectures with high intensity					0.32	0.47		
Number of observations	8,739		2,579		2,889		3,271	
Months of birth	05/1991-04/1997		05/1991-04/1993		05/1993-04/1995		05/1995-04/1997	

Table 5

Descriptive Statistics for Child Mortality

Variables	Model 3		Model 4		Model 5	
	mean	s.d	mean	s.d	mean	s.d
Household characteristics						
Urban	0.18	0.38	0.18	0.38	0.18	0.38
Wealth index score	-0.09	0.91	-0.10	0.87	-0.09	0.88
Access to improved water source	0.81	0.39	0.82	0.39	0.81	0.39
Household head is female	0.37	0.48	0.33	0.47	0.33	0.47
Maternal characteristics						
Mother knows oral rehydration	0.88	0.32	0.89	0.31	0.89	0.31
Mother used contraception at least once	0.29	0.45	0.28	0.45	0.27	0.45
Mother can read	0.55	0.50	0.59	0.49	0.59	0.49
Child characteristics						
Mother's age at birth	28.37	6.24	28.28	6.52	28.28	6.63
First-born	0.21	0.40	0.23	0.42	0.24	0.43

1-23 months since previous birth	0.26	0.44	0.25	0.43	0.23	0.42
24-35 months since previous birth	0.26	0.44	0.27	0.44	0.27	0.44
36 or more months since previous birth	0.48	0.50	0.49	0.50	0.50	0.50
Male	0.50	0.50	0.50	0.50	0.49	0.50
Year of birth fixed effects:						
1990	0.18	0.39				
1991	0.14	0.34				
1992	0.17	0.38				
1993	0.17	0.37				
1994	0.21	0.41				
1995	0.13	0.34				
Genocide intensity						
Cohort exposure in the first two years*	0.42	0.49	2.36	1.83	1.71	1.85
Ratio of deaths among maternal siblings 1994	0.11	0.22	0.11	0.22	0.11	0.22
Prefectures with not intense genocide	0.32	0.47	0.35	0.48	0.36	0.48
Prefectures with moderate intensity	0.35	0.48	0.32	0.47	0.34	0.47
Prefectures with high intensity	0.34	0.47	0.33	0.47	0.31	0.46
Number of observations	7,974		2,099		1,442	
Months of birth	01/1990-12/1995		04/1994-12/1995		08/1994-12/1995	

*This variable is a dummy in Model 3 while it is "number of months" in Model 4 and 5.

Note: Model 3 is about child mortality from age one month up to five years; Model 4 and 5 from age four months up to fiveyears

V. Results

A. Model 1: Infant Mortality

A non-parametric description of infant mortality (see Figure 2) shows that, as expected, the survival curve of children belonging to the generation exposed to the genocide lies under the survival curves of the unexposed groups. Moreover, the log-rank test for the equality of survival curves of the exposed and unexposed groups indicates that they differ significantly from each other.

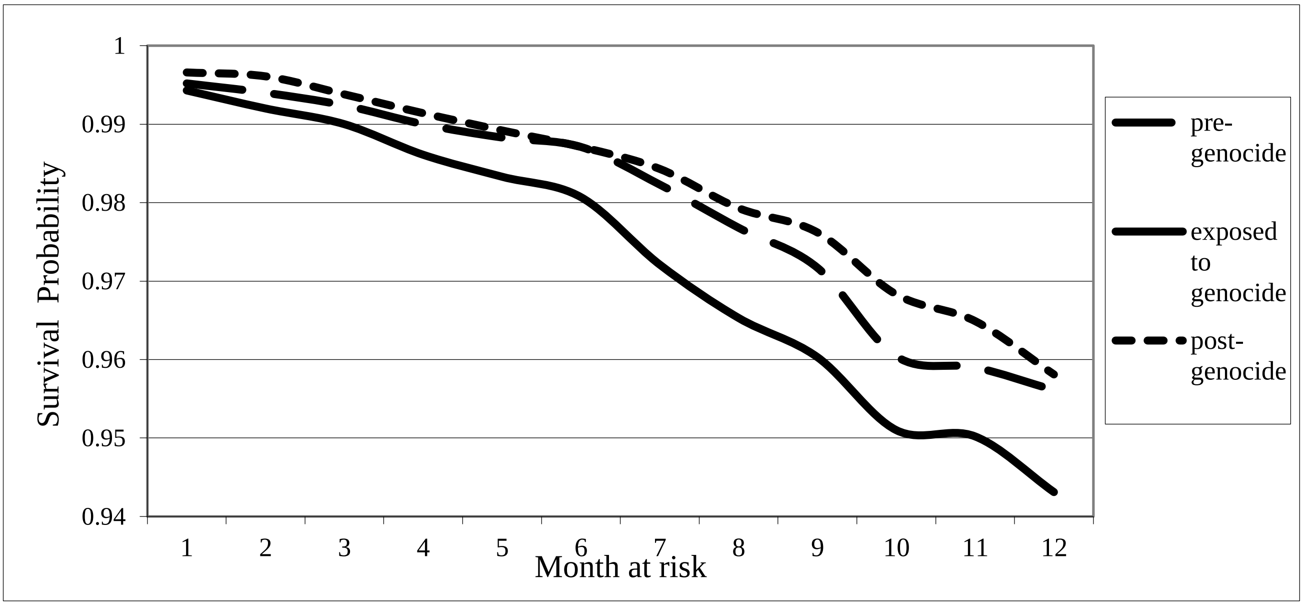

Figure 2

Infant mortality. Survival Curves for Exposed and Unexposed Children

Note: log-rank test for equality of survival functions chi2(2)=80.74; Pr>chi2= 0.00

The results of the parametric *cloglog* duration analysis of infant mortality are presented in Table 6. The estimated coefficients measure the hazard of dying during the first year of life. Children who experienced at least one month of genocide during their first year of life or *in utero*, had a significantly higher hazard of dying than children belonging to the unexposed groups.[16] In terms of hazard ratios, the hazard rate of the pre-genocide group is 24 per cent lower and the hazard rate of the post-genocide group is 35 per cent lower with respect to that of the exposed group. This is a quite relevant effect, compared to other well established individual and household effects on child mortality as, for example, mother's literacy, which reduces the hazard rate by 23 per cent.

As for the other control variables, we find a significant negative correlation between infant mortality and household wealth, mother's use of contraception and knowledge of oral rehydration. Duration

[16] We have also estimated an alternative specification of Model 1 with interaction terms between the dummies concerning exposure to the genocide and the other variables. This specification was potentially interesting, since interaction terms could capture the differences in the role of control variables between the exposed and the unexposed children. However, these interaction terms have turned out to be not significant.

dependence is overall significant and also timing of birth has a large effect. In fact, the higher mother's age at birth, the lower the risk of mortality. Moreover, being the first born, nearly doubles the risk of dying, while the longer the time elapsed from previous births, the lower the risk of mortality. [17]

Table 6.

Results for Model 1:Infant mortality (Exposed and Unexposed Children)

	Coefficients	Exponentiated Coefficients
Prefecture fixed effects		
Kigali urban (base)		
Byumba	-0.02 (0.25)	0.98
Butare	0.21 (0.25)	1.24
Cyangugu	-0.34 (0.29)	0.71
Gikongoro	-0.08 (0.26)	0.92
Gisenyi	-0.22 (0.26)	0.80
Gita rama	0.15 (0.28)	1.16
Kibungo	0.16 (0.25)	1.18
Kibuye	-0.33 (0.26)	0.72
Kigali rural	0.04 (0.26)	1.04
Ruhengeri	-0.25 (0.25)	0.78
Household characteristics		
Rural (base)		
Urban	-0.02 (0.20)	0.98
Wealth index score	-0.18** (0.07)	0.84
No access to improved water source		

[17] We did not find any relevant role for frailty. The reported standard errors are clustered at the community level. We also grouped standard errors at the province level, but this did not produce any sizeable change.

(base)		
Access to improved water source	-0.14 (0.09)	0.87
Household head is male (base)		
Household head is female	0.05 (0.08)	1.05
Maternal characteristics		
Mother does not know oral rehydration (base)		
Mother knows oral rehydration	-0.18* (0.10)	0.84
Mother never used contraception (base)		
Mother used contraception at least once	-0.16* (0.09)	0.85
Mother is not able to read (base)		
Mother is able to read	-0.26*** (0.07)	0.77
Child characteristics		
Mother's age at birth	-0.15*** (0.05)	0.86
Mother's age at birth squared	0.003*** (0.001)	1.00
First-born	0.66*** (0.13)	1.93
1-23 months since previous birth (base)		
24-35 months since previous birth	-0.53*** (0.08)	0.59
36 or more since previous birth	-1.10*** (0.11)	0.33
Female (base)		
Male	0.12* (0.07)	1.12
Exposure to genocide		
Pre-genocide group	-0.27*** (0.08)	0.76
Exposed group (base)		
Post-genocide group	-0.43*** (0.08)	0.65
Number of observations	8,739	
Wald Chi2	14728.47	Prob >chi2=0.0000

Notes: *,**,***: significant at the 10, 5 and 1 per cent respectively. The exponentiated coefficients represent the hazard ratios from the underlying continuous time model. Standard errors in parenthesis are clustered at the community level. Duration dependence is accounted for by means of 12 monthly dummies which are jointly significant at 1 per cent.

B. Model 2 : Infant Mortality of Children Exposed to the Genocide

Table 7 shows the results for Model 2 which focuses on children exposed to the genocide and includes the variables approximating the effect of exposure to violence both at a prefecture and at an individual/household level.

For this sample of children, both intensity of exposure at the prefecture level (*prefectures with very intense genocide*) and at the individual level (*ratio of deaths among maternal siblings*) are significantly and positively associated with the hazard of dying during the first year of life. These two variables increase the hazard ratios by large amounts (46 and 85 percentage points, respectively). This result is also evidence that these two variables are correctly approximating exposure, since they are probably capturing the cases who have died because of the conflict.

Table 7

Results for Model 2: Infant Mortality of the Exposed Children

	Coefficients	Exponentiated Coefficients
Household characteristics		
Rural (base)		
Urban	-0.04 (0.24)	0.96
Wealth index score	-0.21* (0.12)	0.81
No access to improved water source (base)	-	-
Access to improved water source	-0.22* (0.24)	0.80
Household head is male (base)	-	-
Household head is female	0.18 (0.11)	1.19
Maternal characteristics		
Mother does not know oral rehydration (base)	-	-
Mother knows oral rehydration	-0.08 (0.15)	0.92
Mother never used contraception (base)	-	-
Mother used contraception at least once	-0.23*	0.79

	(0.13)	
Mother is not able to read (base)	-	-
Mother is able to read	-0.37*** (0.11)	0.69
Child characteristics		
Mother's age at birth	-0.10 (0.08)	0.90
Mother's age at birth squared	0.001 (0.001)	1.00
First-born	0.57** (0.23)	1.77
1-23 months since previous birth (base)	-	-
24-35 months since previous birth	-0.56*** (0.13)	0.57
36 or more since previous birth	-0.92*** (0.14)	0.40
Female (base)	-	-
Male	0.20** (0.10)	1.22
Genocide intensity		
Prefectures with not intense genocide	-	-
Prefectures with moderately intense genocide	0.04 (0.14)	1.04
Prefectures with very intense genocide	0.38*** (0.13)	1.46
Ratio of deaths among mat. siblings in 1994	0.61*** (0.19)	1.85
Number of observations	2,889	
Wald Chi2	6391.99 Prob > chi2 =0.0000	

Notes: *,**,***: significant at the 10, 5 and 1 per cent respectively. The exponentiated coefficients represent the hazard ratios from the underlying continuous time model. Standard errors in parenthesisare clustered at the community level. Duration dependence is accounted for by means of 12 monthly dummies which are jointly significant at 1 per cent.

C. Model 3: Child Mortality

Table 8 shows the results for child mortality and the effects of exposure in the first two years of life to the genocide. The proxies of the genocide are still significant, even if the significance level is lower, also because part of the effect in this model might be captured by the year of birth fixed effect. In fact, children born in 1993 and 1994 have significantly higher hazard ratios. The interaction term *number of months of exposure *ratio of deaths among maternal siblings in 1994*, however, shows a very sharp increase in the hazard rate (44 percentage points).

Table 8

Results for Model 3: Child Mortality (Exposed and Unexposed Children)

	Coefficients	Exponentiated Coefficients
Household characteristics		
Rural	-	-
Urban	-0.13*** (0.10)	0.88
Wealth index score	-0.22*** (0.05)	0.80
No access to improved water source	-	-
Access to improved water source	-0.23*** (0.06)	0.79
Household head is male	-	-
Household head is female	0.10** (0.05)	1.11
Maternal characteristics		
Mother does not know oral rehydration	-	-
Mother knows oral rehydration	-0.08 (0.07)	0.93
Mother never used contraception	-	-
Mother used contraception at least once	-0.23*** (0.06)	0.80
Mother is not able to read	-	-
Mother can read	-0.19*** (0.05)	0.83
Child characteristics		
Mother's age at birth	-0.24*** (0.01)	0.79
Mother's age at birth squared	0.004*** (0.0003)	1.00
First-born	0.30***	1.35
1-23 months since previous birth	-	-
24-35 months since previous birth	-0.45*** (0.06)	0.64
36 or more since previous birth	-0.92*** (0.07)	0.40
Female	-	-
Male	0.08 (0.05)	1.08
Genocide intensity		
Prefectures with not intense genocide	-	-
Prefectures with moderately intense genocide	0.02 (0.06)	1.03

Prefectures with very intense genocide	0.11* (0.06)	1.12
Number of months of exposure *ratio of deaths among maternal siblings in 1994	0.37** (0.15)	1.44
year of birth fixed effect:		
1990	-	-
1991	0.01 (0.09)	1.01
1992	0.11 (0.08)	1.11
1993	0.25*** (0.08)	1.29
1994	0.21*** (0.08)	1.24
1995	-0.16 (0.10)	0.86
Number of observations 7,974		
Wald Chi2	41057.25	Prob > chi2=0.0000

Notes: *,**,***: significant at the 10, 5 and 1 per cent respectively. The exponentiated coefficients represent the hazard ratios from the underlying continuous time model. Standard errors in parenthesis are clustered at the community level. Duration dependence is accounted for by means of 7 dummies (D1, D1-D3, D4-D6, D7-D12, D13-D36, D37-D48, D49-D60) which are jointly significant at 1 per cent.

D. Model 4 and 5: Child Mortality of the Survivors and of the Exposed While in Utero

Model 4 and 5 aim at capturing the longer term impact of the genocide on the hazard of dying between the fourth and the sixtieth month of life. Table 9 shows that the genocide impacts child mortality even if they have survived it and also if they were just exposed while *in utero*. This results is even more impressive if one notes that, to estimate this model, we have to exclude the first months of life from the analysis (see Section IV-D).

In both Model 4 and 5, the genocide effect stems from household level exposure. In fact, in Model 4 the variable *number of months of exposure *ratio of death among maternal siblings in 1994* increases the hazard rate by 23 percentage points for a child that has been exposed for one month and with one death among its mother's siblings. Since average months of exposure is 2.36 and the average *ratio of death among maternal siblings in 1994* is 0.11 (see Table 5), the average increase of the hazard rate of mortality in the sample of survivors is around 6 percentage points. This result holds true in Model 5, where the variable *number of months of exposure *ratio of death among maternal siblings in 1994* increases the risk of child mortality by an even larger amount, namely, 28 percentage points. The difference between the two coefficients in Model 4 and 5 is, however, not significant.[18] At variance with the preceding models, genocide intensity in the prefecture of residence is no longer significant.

We interpret these results as evidence that what would matter most for child mortality rates of the survivors is the experience of the genocide at a household level, approximated by the ratio of deaths among maternal siblings in 1994. This is a valuable indication for identifying the target group of children of any policy action aimed at improving child health after a war.

[18] We have tested this hypothesis by re-estimating Model 4 with two variables: *number of months of only in utero exposure *ratio of death among maternal siblings in 1994* and *number of months of exposure in utero AND in life OR only in life *ratio of death among maternal siblings in 1994* . We have then tested for equality of the coefficients of these variables.

Table 9

Results for Model 4 and 5: Child Mortality of the Survivors and of the Exposed while In Utero

	Model 4		Model 5	
	Coefficients	Exponentiated Coefficients	Coefficients	Exponentiated Coefficients
Household characteristics				
Rural	-	-	-	-
Urban	-0.22 (0.17)	0.80	-0.19 (0.33)	0.82
Wealth index score	-0.29* (0.15)	0.74	-0.37* (0.19)	0.69
No access to improved water source	-	-	-	-
Access to improved water source	-0.31** (0.14)	0.73	-0.34* (0.17)	0.71
Household head is male	-	-	-	-
Household head is female	-0.02 (0.13)	0.98	-0.21 (0.16)	0.81
Maternal characteristics				
Mother does not know oral rehydration	-	-	-	-
Mother knows oral rehydration	0.05 (0.19)	1.05	0.097 (0.24)	1.10
Mother never used contraception	-	-	-	-
Mother used contraception at least once	-0.24 (0.16)	0.79	-0.16 (0.19)	0.85
Mother is not able to read	-	-	-	-
Mother can read	-0.33*** (0.13)	0.72	-0.33** (0.16)	0.72
Child characteristics				
Mother's age at birth	0.02 (0.09)	1.02	0.05 (0.11)	1.05
Mother's age at birth squared	0.001 (0.001)	1.00	-0.001 (0.002)	0.998
First-born	0.40* (0.23)	1.49	0.75** (0.30)	2.12
1-23 months since previous birth	-	-	-	-
24-35 months since previous birth	-0.44*** (0.16)	0.64	-0.41** (0.19)	0.66
36 or more since previous birth	-0.81*** (0.18)	0.45	-1.06*** (0.24)	0.34
Female	-	-	-	-
Male	0.07 (0.12)	1.08	0.04 (0.15)	1.04
Genocide intensity				
Prefectures with not intense genocide	-	-	-	-
Prefectures with moderately intense genocide	0.05	1.05	0.18	1.20

	(0.15)		(0.18)	
Prefectures with very intense genocide	-0.17	0.85	-0.09	0.91
	(0.14)		(0.18)	
Number of months of exposure *ratio of deaths among maternal siblings in 1994	0.21***	1.23	0.25**	1.28
	(0.07)		(0.11)	
Number of observations	2,099		1,442	
Wald Chi2	9010.23	prob>Chi2= 0.0000	6011.75	prob>Chi2= 0.0000

Notes: *,**,***: significant at the 10, 5 and 1 per cent respectively. The exponentiated coefficients represent the hazard ratios from the underlying continuous time model. Standard errors in parenthesis are clustered at the community level. Duration dependence is accounted for by means of 6 dummies (D5-D6, D7-D12, D13-D24, D25-D36, D37-D48, D49-D60) which are jointly significant at 1 per cent.

V. Concluding remarks.

This paper exploits difference across birth cohorts during the Rwandan genocide to estimate the effects of civil war exposure on child mortality. Despite adults, and males in particular, were the main target of the violent conflict, we find that, considering both *in utero* and postnatal war exposure, the impact of the genocide has increased infant and child mortality by significant amounts. Moreover, our results clearly show that the differential intensity of exposure to the genocide both at the household and at the prefecture level matters, thus indicating that aid intervention should not be indiscriminate, but well targeted and context-based even during emergencies.

As far as the temporal extent of the impact of the genocide is concerned, our results show that children born during the genocide and who survived it, and even children who experienced it only *in utero*, continue to have higher mortality rates after the war. We estimate that the average increase in the hazard rate of child mortality in the sample of survivors is around 6 percentage points. These results point to the existence of a fragile generation of children that needs to be safeguarded well after the end of the critical stage of the war. Our results also point to the crucial role of children's experience of the genocide in their households, which we have measured in terms of deaths among maternal siblings. We reckon this to be a valuable indication to identify the target group of any policy action aimed at improving child health also several years after a war.

References

Akresh, Richard, Sonia Bhalotra, Marinella Leone and Una Okonkwo Osili. 2012. "War and Stature: Growing Up during the Nigerian Civil War." *American Economic Review* 102(3): 273-77.

Akresh, Richard and Damien De Walque. 2010. "Armed Conflict and Schooling: Evidence from the 1994 Rwandan Genocide*". Policy Research Working Paper 4606*. The World Bank.

Akresh, Richard, Philip Verwimp and Tom Bundervoet. 2011. "Civil War, Crop Failure, and Child Stunting in Rwanda." *Economic Development and Cultural Change* 59(4): 777-810.

Almond, David. 2006. "Is the 1919 Influenza Pandemic Over? Long –Term Effects of *In Utero* Influenza Exposure in the Post-1940 U.S. Population." *Journal of Political Economy* 114(4): 676-712.

Banerjee, Abhijit, Esther Duflo, Gilles Postel-Vinay, and Timothy Watts. 2010. "Long Run Health Impacts of Income Shocks: Wine and Phylloxera in 19th Century France." *Review of Economics and Statistics* 92(4) : 714-728.

Black, Robert, et al.. 2008. "Maternal and Child Undernutrition: Global and Regional Exposures and health Consequences." *The Lancet* , published online January 17. DOI:10.1016/S0140-6736(07)61690-0, pp.5-22

Bundervoet, Tom, Philip Verwimp, and Richard Akresh. 2009. "Health and civil war in rural Burundi." *Journal of Human Resources* 44 (2): 536-563.

Chossudowsky, Michel. 1996. “Economic Genocide in Rwanda”. *Economic and Political Weekly* 31(15): 938-941.

Currie, Janet. 2008. "Child Health and Mortality." *The New Palgrave Dictionary of Economics*. Second Edition. Eds. Steven N. Durlauf and Lawrence E. Blume. Palgrave Macmillan.

De Walque, Damien, and Philip Verwimp. 2009. “The Demographic and Socio-Economic Distribution of Excess Mortality during the 1994 Genocide in Rwanda.” *Journal of African Economies* 19(2):141-162.

DHS. 2008. *Description of the Demographic and Health Surveys Individual Recode*; Calverton, Maryland; U.S.A.; available online at http://www.measuredhs.com/pubs/pdf/DHSG4/Recode3DHS.pdf.

Eswaran, Mukesh. 2002. “The Empowerment of Women, Fertility, and Child Mortality: Towards a Theoretical Analysis”. *Journal of Population Economics* 15(3): 433-454.

Filmer, Deon and Lant H. Pritchett. 2001.“Estimating Wealth Effects without Expenditure Data or Tears: an Application to Educational Enrollments in States of India*”*. *Demography* 38(1): 115-132.

Hong, Rathavuth, Mohamed Ayad, Shea Rutstein and Ruilin Ren. 2009. “Childhood Mortality in Rwanda: Levels, Trends, and Differentials. Further Analysis of the Rwanda Demographic and Health Surveys, 1992-2007/08”. *DHS Further Analysis Reports* 6. Calverton, Maryland, USA: ICF Macro.

Institut National de la Statistique du Rwanda (INSR). 2001. “Rwanda Demographic and Health Survey 2000”. Calverton, Maryland, USA: ICF Macro.

Jenkins, P. Stephen. 1995. “Easy Estimation Methods for Discrete-Time Duration Models”. *Oxford Bulletin of Economics and Statistics* 57: 129–138.

Justino, Patricia and Philip Verwimp. 2008. “Poverty Dynamics, Violent Conflict and Convergence in Rwanda”. *MICROCON Research Working Paper* 4.

León, Gianmarco. 2012. “Civil Conflict and Human Capital Accumulation: The Long-Term Effects of Political Violence in Perú.” *Journal of Human Resources* 47: 991–1022.

Maccini, Sharon and Dean Yang. 2009. “Under the Weather: Health, Schooling, and Economic Consequences of Early-Life Rainfall”. *American Economic Review* 99(3): 1006–26.

Meng, Xin, and Nancy Qian. 2009. “The Long Term Consequences of Famine on Survivors: Evidence from a Unique Natural Experiment Using China's Great Famine.” *NBER Working Paper Serie*s 14917.

Mosley, W. Henry and Lincoln C., Chen . 1984. “An Analytical Framework for the Study of Child Mortality in Developing Countries”. *Population and Development Review* 10(Supplement: Child Survival: Strategies for Research): 25-45.

Newbury, Catharine. 1998. “Ethnicity and the Politics of History in Rwanda”. *Africa Today* 45(1): 7-24.

OAU. 1999. “Rwanda: the Preventable Genocide”. Organization of African Unity. Available on line at http://www.africa-union.org/official_documents/reports/Report_rowanda_genocide.pdf.

Rothenberg B. Pearila and Varga E. Phillis. 1981. “The Relationship between Age of Mother and Child Health and Development”. *American Journal of Public Health* 71(8): 810-817.

Rutstein, Shea. 2008. “The DHS Wealth Index. Approaches for Rural and Urban Areas”. *DHS Working Papers* 60. Calverton, Maryland, USA: ICF Macro.

Shemyakina, Olga. 2011. "The Effect of Armed Conflict on Accumulation of Schooling: Results from Tajikistan". *Journal of Development Economics* 95(2): 186-200.

Stein, Zena Mervyn Susser, Gerhart Saenger, Francis Marolla. 1975. “Famine and Human Development: the Dutch Hunger Winter of 1944–1945”. New York: Oxford University Press.

Strauss, John, and Duncan Thomas. 1998. “Health, Nutrition, and Economic Development”. *Journal of Economic Literature* 36(2): 766-817.

Van der Klaauw, Bas. and Limin Wang. 2011. “Child Mortality in Rural India”. *Journal of Population Economics* 24: 601–628.

Verwimp, Philip. 2003. “The Political Economy of Coffee, Dictatorship, and Genocide”. European Journal of Political Economy.19(2): 161–181.

Victora, G. Cesar, Jennifer Bryce, Olivier Fontaine and Roeland Monasch. 2000. Reducing Deaths from Diarrhea through Oral Rehydration Therapy. *Bulletin of the World Health Organization* 78(10): 1246–55.

Winikoff, Beverly. 1983. "The Effects of Birth Spacing on Child and Maternal Health". *Studies in Family Plannin*g 14(10): 231-245.