Journal of African Economies, Vol. 19, number 2, pp. 141–162
doi:10.1093/jae/ejp029 online date 22 January 2010

The Demographic and Socio-economic Distribution of Excess Mortality during the 1994 Genocide in Rwanda

D. de Walque[a,*] and P. Verwimp[b]

[a]The World Bank, Development Research Group
[b]Fund for Scientific Research (Flanders, Belgium), University of Antwerp and Université Libre de Bruxelles

* Corresponding author: E-mail: ddewalque@worldbank.org

Abstract

This paper studies the demographic consequences of the Rwandan genocide and how the excess mortality due to the conflict was distributed in the population. Data collected by the 2000 Demographic and Health Survey indicate that although there were more deaths across the entire population, adult males were the most likely to die. Using the characteristics of the survey respondent as a proxy for the socio-economic status of the victims' family, the results also show that individuals with an urban or more educated background were more likely to die. The country's loss of human capital is a long-term cost of the genocide that compounds the human tragedies.

JEL classification: J10, O10, R20

1 Introduction

This paper studies the long-term demographic consequences of the Rwandan genocide (1994) and, in particular, analyses how excess mortality was distributed in the population. This study complements earlier work by Verwimp (2003a, b, 2004, 2005). The analysis uses the siblings' mortality module of the 2000 Demographic and Health Survey (DHS) in Rwanda to analyse mortality during 1994. The maternal mortality module collects from female survey respondents the following information: number of

brothers and sisters born from the biological mother of the respondent and, for each of the siblings, gender, survival status, age and age at death if relevant. De Walque (2005, 2006) has used this method to analyse selective mortality during the Khmer Rouge Period in Cambodia.

While de Walque (2005) found that, in the case of Cambodia, more educated and urban individuals were more likely to have been victimised, Bellows and Miguel (2009) did not find that gender, age and education were associated with victimisation during the civil war in Sierra Leone, even though they found that traditional chiefs were more likely to be targeted.

We find that the excess mortality of 1994 dramatically affected the population composition of Rwanda. Adults, especially males, were most likely to die, indicating that violent deaths represented a large share of the excess mortality, since in more peaceful times, mortality is higher among infants than among relatively young adults. Using the characteristics of the respondent sister as a proxy for the socio-economic status of the family, we also establish that individuals with an urban or educated background were more likely to die. We consider the possibility that these two results are driven by the fact that Tutsis were especially targeted by the 1994 genocide. Indeed, we find, using the 1992 DHS, that Tutsis were more likely to be educated and to live in urban areas. Since ethnic variables have not been collected in the 2000 DHS, we acknowledge that our analysis suffers from an omitted variable bias. Nevertheless, we can conclude that the genocide represented, beyond the human tragedies, a huge negative shock for the human capital in Rwanda, since the more educated and urban groups of the population were more likely to be victims.

The paper's objective is to increase our understanding of the micro-level dynamics of violent conflict. First, by analysing the socio-economic characteristics of the victims, we better understand the direction of the violence, which brings us closer to the intentions or motivations of the perpetrator. Further, the analysis also adds insights into the long-term consequences of the 1994 genocide, in particular the loss of human capital.

There is an extensive literature on the Rwandan genocide and other violent conflicts, but few papers address the profiles of victims or perpetrators, or more broadly the micro-level dynamics of the violence. Using a small sample from Northern Rwanda, André and Platteau (1998) found that land issues, land endowment and more general wealth and social status played an important role in the genocidal dynamic at the local level. Their sample was almost entirely Hutu. Kalyvas (2006) convincingly demonstrates that local participants in violence during civil war more often than not have other agendas than the macro-level narrative that is

supposedly driving the conflict. Verwimp (2003b), using a small sample from southern Rwanda, shows that older and wealthy Rwandans had a higher propensity to be killed in the genocidal violence, even after controlling for ethnicity. Bundervoet (2009), in an analysis of victim profiles from the 1993 massacres in Burundi, finds that wealth in terms of livestock and human capital increased the propensity to be killed. de Walque (2005) shows that educated and urban residents were more likely to be killed in Cambodia under the Khmer Rouge. Akresh and de Walque (2008) found that the 1994 genocide in Rwanda had a lasting negative impact on the educational achievement of children who were of school going age in 1994. A common result from the empirical work of the mentioned authors is that the killing of an individual, even during a massacre or genocide, is not a random event. Victims are deliberately targeted, be it for their ethnicity, status, wealth, education, gender, religion or political conviction.

The paper is structured as follows. Section 2 gives a short overview of the Rwandan genocide. Section 3 presents the methodology and the data. Section 4 describes the main results, whereas Section 5 discusses the omitted variable bias caused by the absence and concludes.

2 Short history of the Rwandan genocide

Between April and July 1994, between 500,000 and 800,000 Tutsis (Prunier, 1995; Des Forges, 1999) or about 75% of the Tutsi population together with many Hutu who were known to be opponents of Habyarimana were killed by the Rwandan military (Forces Armées Rwandaises, FAR), local police, national guard and militia called Interhamwe. A few years before, in October 1990, a group of rebels consisting of Tutsi refugees who had left Rwanda during the 1959–62 revolution, together with their offspring, attacked Rwanda from Uganda. What followed was a civil war between the Rwandan armed forces (FAR) and the rebel army (Rwandan Patriotic Front, RPF) in which the civilian population in the north of Rwanda was the main victim. While the RPF claimed to fight against the dictatorship of president Habyarimana, the latter claimed to represent the majority of the people. The battles between both armies were paralleled by peace negotiations and third party interventions. In order to understand the drama of this period, it is essential to know its history.

The ethnic composition of the population had been a major issue in Rwandan politics since the time of colonisation. The Belgian coloniser

had first favoured the Tutsi ruling class because they were considered racially superior to the Hutus, who were considered a people of cultivators. In the 1950s, with the spread of anti-colonial and independence movements, the ruling Tutsis began to claim the independence of Rwanda. At that time a Hutu counter-elite was given the chance to study at catholic seminars. With Belgian military and political aid, this new elite of Hutu leaders succeeded in overturning the ruling Tutsi regime and replace it by the leadership of the *Parmehutu*, the party for the emancipation of the Hutu. Grégoire Kayibanda, a seminarian, became the first president. The ethnic divide however remained and was even strengthened. The new rulers, at the national as well as at the local level, established their power by removing all Tutsis from positions of power. Ordinary Tutsis who were not associated with political power were also targets of reprisal and murder. For detailed treatment of the history of Rwanda, we refer to books written by Prunier (1995), Newbury (1988), De Lame (1996), Reyntjens (1994) and Chrétien (2000) among others.

In 1973 a group of army officers around Juvénal Habyarimana took power by a coup d'état. They were frustrated by the monopolisation of power by the group around Kayibanda, whose power base was the central prefecture of Gitarama. The group around Habyarimana, originating from northern Rwanda, saw all benefits of power go to the people from Gitarama. After the coup d'état, Habyarimana became the new president. He established the MRND (Mouvement Révolutionnaire National pour le Développement), the single party whom every Rwandan was supposed to belong to by birth. Aided by high prices for the coffee, the country's main export crop, in the late 1970s and generous donor support, Habyarimana was liked, or at least not contested, by a large part of the population. He did not abolish the ethnic identity cards and forbade officers and soldiers to marry Tutsi wives. In order to control population movements, he set up a detailed system of registration and reporting of demographic changes at the local level. He also had every adult participate in the *Umuganda* (weekly communal labour), and institutionalised weekly animation sessions in honour of himself (Verwimp, 2003a).

A key characteristic of the Habyarimana regime was its doctrine on the relation between population and land. The president had never been an advocate of a family planning policy. On several occasions he declared that children were the wealth of every Rwandan family. Groups set up by the Ministry of the Interior attacked pharmacies that sold condoms. The president was fully supported by the Catholic Church, which was omnipresent in Rwanda. The fertility rate of Rwandan women was

among the highest in the world and the average size of cultivated land per family was shrinking rapidly from 1.2 ha in 1984 to 0.9 ha in 1990 (Département de Statistique Agricole, 1984; 1989–91). Many families had not enough land to earn a living and feed their families. In 1986, when discussing the fate of the 1959–62 refugees, the Central Committee of the MRND said that their return was not possible because the country was overpopulated.

During the civil war preceding the genocide (1990–94), a number of local massacres occurred in which a total of 2,000 Tutsis were killed. These massacres were not spontaneous outburst of violence from a poor peasant population but were organised by the national power elite. On 6 April 1994, Habyarimana's plane was shot down. After that, the genocide broke out.

3 Methodology and data description

We use the 1992 and the 2000 DHS for Rwanda. The 2000 survey includes a module collecting information on all the siblings of the respondent, including siblings who have died. The respondent is always an adult female, aged 15–49. We thus have information on the date of birth, the sex and, in case of death, the date of death of all siblings of the adult female interviewed in the 2000 DHS. One advantage of the mortality module is that it greatly increases the size of the population from which mortality estimates are calculated. Using this module, we increase the number of cases in our analysis from roughly 10,000 adult females to close to 45,000 siblings of the survey respondents. In addition, compared with many studies about mortality, it is not drawn from a sample of convenience (e.g., refugees), since the DHS are administered to a randomly selected representative sample of the population.

There are, however, several methodological issues implied by using a sample of survivors. Even with a nationally representative sample, estimates based on a sample of survivors are potentially subject to several shortcomings (see, for example, Heuveline, 1998, 2001a, b about estimates of the number of deaths during the Khmer Rouge period in Cambodia). First, the method relies on recall of past events and is therefore possibly prone to misreporting. Several tests of data quality are performed in the DHS report and there does not seem to be systematic reporting biases; the sex ratios at birth are in the internationally acceptable range, suggesting that there is no serious under- or over-reporting of brothers or sisters.

Similarly, the median year of birth is the same for respondents as for siblings, indicating that there is no underreporting of older siblings. When more than one respondent in the same household reported on the same sibship, only one respondent was randomly retained.

Given the way the adult mortality schedule is constructed, we miss entirely families in which only males were born and we are likely to underrepresent families where a majority of males were born. But this is only likely to have an impact if we think that mortality in the genocide was affected not only by one's own gender (which was the case, as we will show) but also by the gender composition of one's own sibship.

Another methodological issue is that for siblings from a family to have a chance to be represented in the survey, at least one of the siblings need to have survived until the date of the survey. In other words, the survey misses the families where all siblings died and is likely to over-sample families with many survivors (Gakidou and King, 2006). This means that the survival probabilities of brothers and sisters are not independent. This is, therefore, likely to lead to an underestimation of the extent of the mortality. This problem is more likely to occur during extreme mortality crises, like the genocide in Rwanda, when the deaths among siblings might be highly correlated. To account for the unequal probability of selection into the sample, we weighted the data by a factor of the inverse of the number of surviving females aged 15–49 in each family. We will also not include the respondent in the counts, but only her siblings, because otherwise mortality would be further underestimated since, by definition, respondents are all survivors.

We should, however, keep the risk of underestimation of deaths in perspective. While it is correct that, often, members of Tutsi households (parents and children living in the same dwelling) were killed at the same time, at the same place and by the same people (Verwimp, 2003a, b), this is not the case for adult brothers and sisters who had already started their own households before the genocide. Married sisters and brothers do not live with each other but with their respective partners, thereby increasing the probability that at least one of the adult brothers or sisters survived the genocide. Given that on average Rwandan mothers gave birth to eight children in the period covered by the 1992 and 2000 DHS, it is very likely that at least one of them will have survived the genocide. With the maternal mortality module, this is precisely what we are capturing: the death and survival of the siblings of the adult female, not of current household members.

Despite the shortcomings, the mortality estimates—derived from the siblings' data from a large representative sample—offer useful insights.

Even if they might underestimate the number of deaths, they provide an accurate measure of the impact of mortality on the current population structure of Rwanda. Such data also allow the analysis to address questions about the timing and the socio-economic distribution of excess mortality that cannot be answered with other approaches like the reconstruction approach that compares population counts and distributions from one census to the other (for the case of Cambodia, see Heuveline, 2001a, b).

In the siblings' data collected in a nationally representative DHS, there is no direct information on the socio-economic status of the siblings. However, we argue that by using information about the respondents, it is possible to proxy the socio-economic status of the family. For example, the schooling levels of the female respondents can be considered a good indicator of the social and educational status of their family. Using characteristics of the surviving female sibling does not fully reveal the characteristics of her surviving or deceased brothers and sisters. We are aware of the intra-household variation in educational attainment and place of residence after marriage. However, educational attainment, as well as urban residence, needs to be considered in the context of pre-genocide Rwanda. Since few people were educated (see Table 1, only 10% of sisters continued beyond the primary level), the mere fact of having an educated sister signals that one's parental household was able and willing to invest in human capital accumulation. Even when not all siblings receive secondary or higher education, the willingness together with the ability of the household to make such investment reveals that the parental household was pro-education. The higher probability to be killed for siblings of an educated sister can thus be interpreted as an attack on the (offspring of) households who invested in human capital formation.

This interpretation is in accordance with two related observations. First, the Habyarimana regime espoused a peasant ideology which considered intellectuals as 'petit bourgeois' and bourgeois values were judged to ran counter to the doctrine of the Hutu Revolution (Verwimp, 2000, 2006; Boudreaux, 2009). Second, in neighbouring Burundi, research on the profile of victims from the 1993 massacres revealed a similar pattern as in Rwanda, with parents with educated children more likely to die (Bundervoet, 2009).

Our finding for the urban residence of the sister can be interpreted along similar lines. Upon marriage Rwandan women follow their husbands and will live with him in his (new) residence. Given the importance of land, marriage often entails rural to rural migration because the husband will use and later inherit (parts of) his father's land. If the sister-sibling lives

Table 1: Descriptive Statistics

	All	Male	Female	Sister urban in 1994	Sister rural in 1994
Died in 1994	0.127 (0.005)	0.132 (0.005)	0.121 (0.007)	0.142 (0.007)	0.119 (0.006)
Age in 1994	20.55 (0.167)	20.65 (0.183)	20.43 (0.190)	18.86 (0.251)	21.49 (0.214)
Sister with no education	0.286 (0.009)	0.285 (0.010)	0.288 (0.009)	0.215 (0.011)	0.326 (0.010)
Sister with some primary	0.611 (0.008)	0.612 (0.009)	0.609 (0.008)	0.618 (0.013)	0.607 (0.009)
Sister with at least some secondary	0.103 (0.008)	0.103 (0.008)	0.102 (0.008)	0.166 (0.015)	0.067 (0.006)
Sister's years of education	3.71 (0.085)	3.71 (0.088)	3.71 (0.087)	4.52 (0.123)	3.25 (0.076)
Sister lived in urban area in 94	0.361 (0.012)	0.356 (0.012)	0.367 (0.012)	–	–
Total	44,727	22,367	22,301	17,792	26,935

The data are taken from the siblings' mortality data of the DHS, 2000, Rwanda. The data are weighted as recommended by the data provider, and adjusted to account for unequal probability of selection into the sample by a factor of 1/number of surviving females aged 15–49 in each family. When more than one respondent in the same household reports on the same sibship, only one respondent is randomly retained. The background of the family is derived from the characteristics of the sister who answered the survey. For sisters who never moved or moved for the last time before 1994, the actual location is recorded. Sisters who moved after 1994 are assumed to have been living in 1994 in the same type of location as the one reported, in 2000, as the previous one. Robust clustered standard errors between brackets.

in an urban environment it means that her parental household or her husband (after marriage) also lives in a city. As in the case of education, this urban residence again reveals the urban character of the new or parental household of the sibling-sister. Her residence signals the urban character of her entire family. Having urban links, through family or marriage was considered 'high class' in predominantly' rural Rwanda. The higher probability to be killed for siblings of a sister with urban residence can thus be interpreted as an attack on the (offspring of) households with urban links. This interpretation is again in accordance with the peasant ideology espoused by the regime of the Second Republic. This ideology had an openly anti-urban rhetoric (Verwimp, 2000, 2006).

We further verified the existence of a positive correlation between the education of siblings by observing households in which several adult

daughters (age 15 and above) of the head of the household were residing. Within each household, the correlation between the education of the first daughter and the second daughter (n=514 pairs) was 0.665. It was 0.706 (n=87 pairs) between the first and the third daughter, and 0.698 (n=87 pairs) between the second and the third daughter. When regressing education of the first daughter on the education of the second daughter and controlling for the age of both, the coefficient on the education of the second daughter was 0.757, with a t-statistic of 19.61 (n=514 pairs). The correlation between the education of brothers and sisters still living in the same household is fairly similar. For children aged 15 and more, the correlation, within each household, between the education of the first daughter and the education of the first son was 0.635 (n=485 pairs). When regressing the education of the first son on the education of the first daughter and controlling for the age of both, the coefficient on the education of the first daughter was 0.663, with a t-statistic of 17.63 (n=485 pairs).

For the type of residence, one variable indicates whether the respondent is living in a rural or an urban area. Combined with variables about migration history, this allows us, in most cases, to determine whether the family was living in a rural or an urban area in 1994. For individuals who never moved, or who moved for the last time before 1994, the current residence is the residence in 1994. For individuals who moved after 1994, the survey only records the type of residence immediately prior to the last move. If there was only one move between 1994 and 2000, this does not constitute a problem. If there has been several moves between 1994 and 2000, we cannot be certain of the type of residence in 1994, but we make the assumption that the type of residence (urban vs. rural) immediately prior to the last move is the same type of residence than in 1994. As a robustness check, we also relaxed this assumption and performed the analysis on the sub-sample for which we had certainty about their rural/urban location before 1994. The results were very similar. This gives us the type of residence in 1994 of the respondent sibling. We use this information and the assumption that siblings share common characteristics and background to determine whether the other siblings have a rural or an urban background.

The Rwanda 2000 DHS has one major drawback for the present analysis: it does not contain the ethnicity of the respondent. The Government of Rwanda no longer allows the registration of ethnicity, thereby complicating our analysis. It is namely generally acknowledged that the 1994 genocide targeted mainly Tutsi. Econometrically, this is the equivalent of an

omitted variable problem. A variable, ethnicity, determines the probability to die and we cannot include it in the analysis. We discuss this problem in Section 5.

4 Demographic and socio-economic distribution of excess mortality in 1994

Our analysis proceeds in two steps: first, we provide descriptive statistics about trends in mortality for different categories (by gender, birth cohort and socio-economic status) as illustrated in Figures 1–5. In a second stage, we will verify the robustness of the findings from the descriptive trends in a multivariate regression framework.

Our results indicate that the excess mortality of 1994 dramatically affected the population composition of Rwanda. Figure 1 very simply plots, without any adjustment for the number and the age of individuals at risk in each year, the number of deaths reported among siblings in each year. It illustrates very clearly that excess mortality was heavily concentrated in 1994.

Mortality in Rwanda in 1994 was not only due to the genocide and the war, mass migrations, very poor health conditions and a cholera epidemic in refugee camps also contributed to the excess mortality. However, the distribution of the death probabilities by birth cohort in 1994, illustrated in Figure 2, is evidence that a considerable proportion of the excess mortality is due to violent deaths, since it is not the birth cohorts most vulnerable to poor health and diseases, such as children, who experienced the highest mortality. Adults, and to a larger extent adult males, were most likely to die. For comparison purposes, Figures 2–5 also include the death probabilities for 1990,[1] four years before the genocide. The comparisons indicate clearly that mortality was order of magnitudes higher in 1994 and that the distribution of mortality by age and gender was very different than in normal years.

Using the characteristics of the respondent sister as a proxy for the socio-economic status of the family, Figures 3–5 establish that individuals with an urban or educated background were more likely to die. Figure 3 shows that at all ages, individuals with an urban background, i.e., siblings of women who lived in urban areas in 1994, were more likely to die in

[1] Notice that in Figures 2–5, the number of observations becomes smaller at older age, especially in the age 46–50 category in 1990, explaining a higher variability of the estimates.

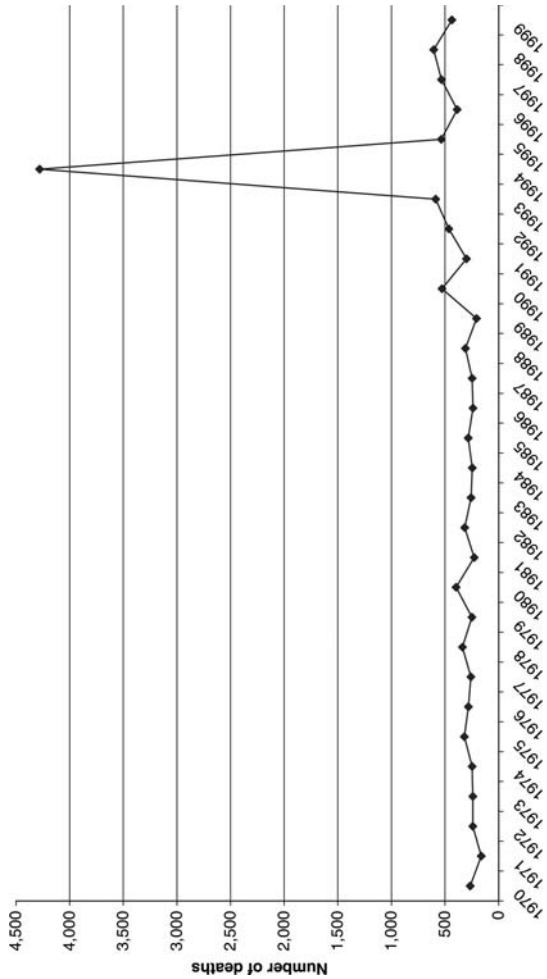

Figure 1: Number of Deaths by Year among Siblings of Women Aged 15–49. DHS, Rwanda, 2000

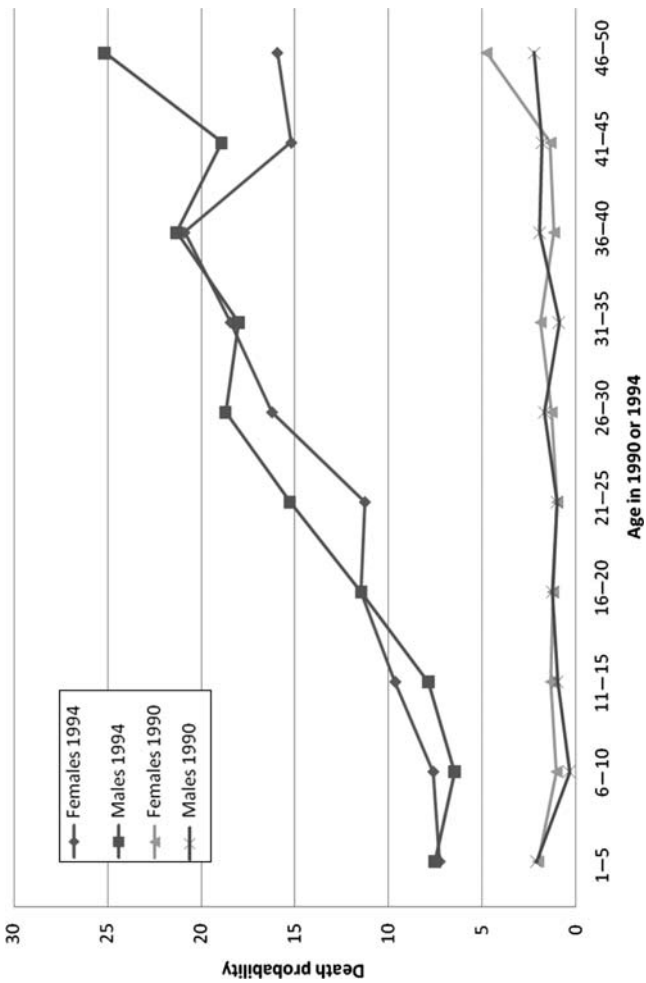

Figure 2: Death Probability in 1990 and 1994, by Age and Gender. From Siblings' Mortality Data, Demographic and Health Survey, Rwanda, 2000

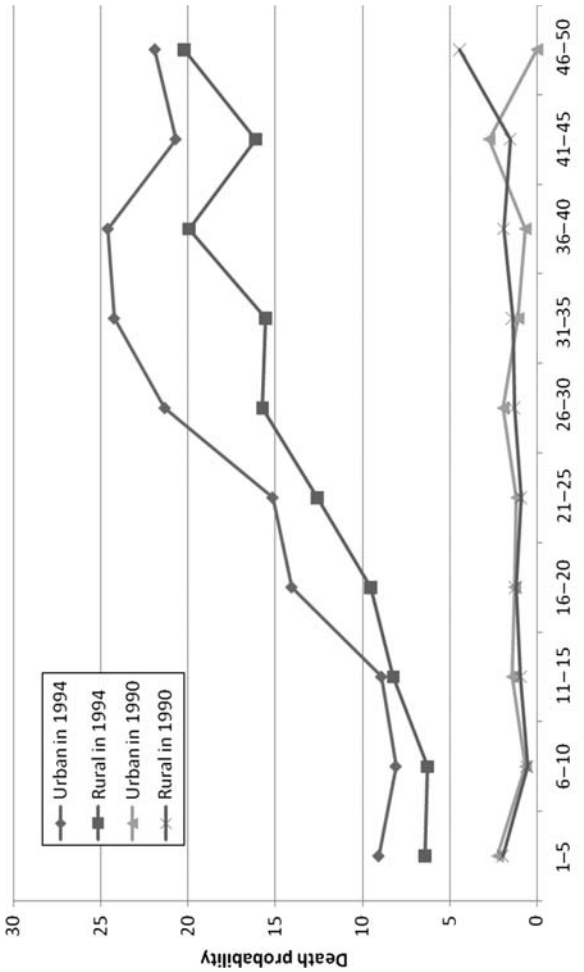

Figure 3: Death Probability in 1990 and 1994, by Rural/Urban Location of the Family. From Siblings' Mortality Data, DHS, Rwanda 2000

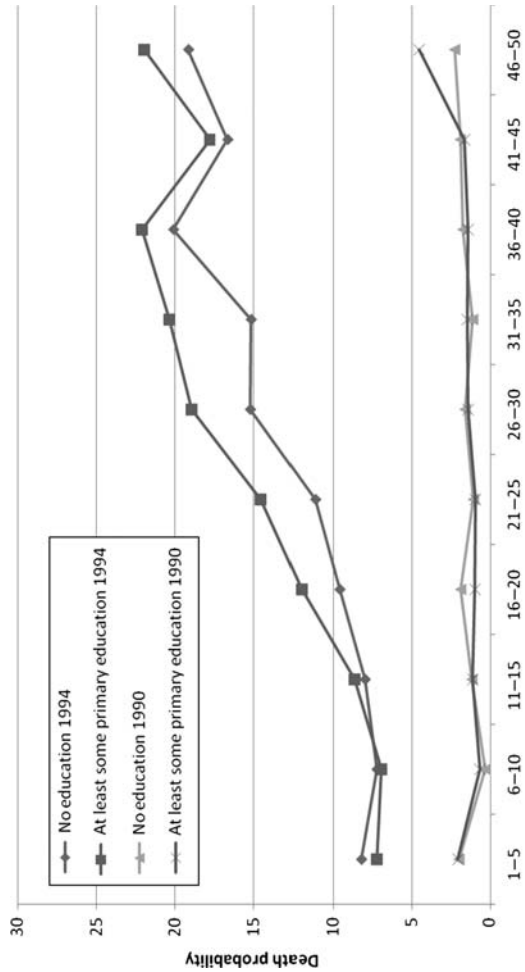

Figure 4: Death Probability in 1990 and 1994, by Family's Educational Background. From Siblings' Mortality Data, DHS, Rwanda 2000

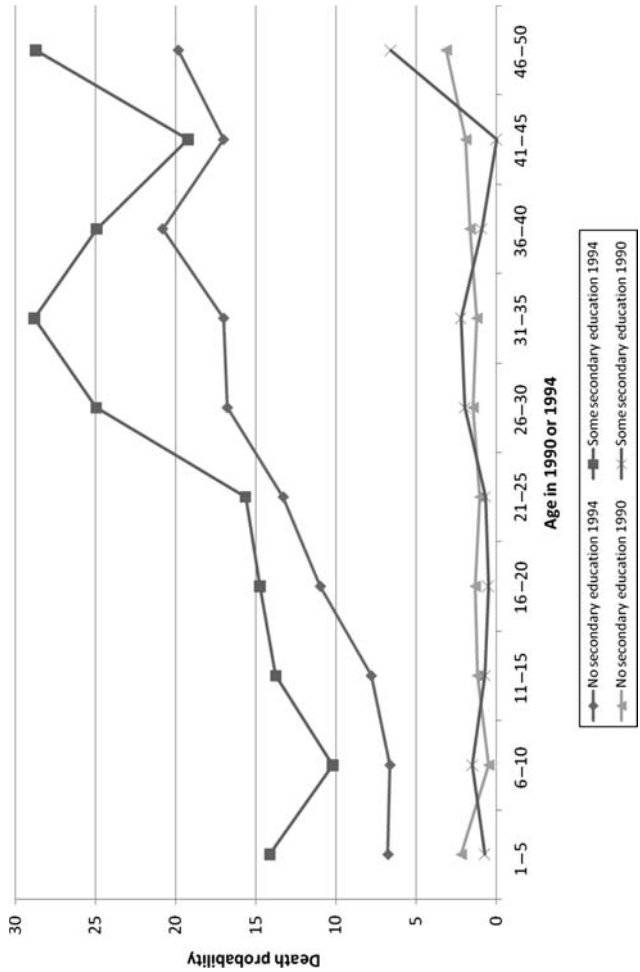

Figure 5: Death Probability in 1990 and 1994, by Educational Level of the Sister. From Siblings' Mortality Data, DHS, Rwanda 2000

1994. That differential increases after age 15. The comparison with 1990 clearly shows that such a difference in mortality by rural or urban location was not present before the genocide. Figures 4 and 5 follow the same format for the educational background of individuals. Figure 4 shows that siblings of women with at least some primary education were more likely to die, at adult ages, than individuals whose sister had no education. Figure 5 is constructed in the same way and establishes that individuals who had a sister who attended secondary school were more likely to experience excess mortality. In Figure 5, which compares secondary education with lower schooling achievements, the magnitude of the differential is larger and extends over all ages, even if it still peaks among adults. Again, in Figures 4 and 5, the comparison with mortality in 1990 indicates that differential mortality by educational background is unique to 1994. Figures 2–5 are very suggestive, but they illustrate only a univaried analysis.

In a second step, we perform a logit analysis estimating the following specification:

$$E(Y_i) = P_i = L(\alpha + \beta X_i)$$

where Y_i represents the probability to die in 1994 and assumes value 1 or 0. X is a vector of sibling and family characteristics. The regressors of interest are the gender and dummies for the age of the sibling in 1994 and the rural and the educational backgrounds of the family. The data are weighed with the population weights provided in the DHS as well as with the inverse of the number of surviving females age 15–49 in each family and the standard errors are clustered by enumeration area.

Table 1 contains descriptive statistics of the variables used in the regression analysis. It is important to remember at this stage that the education and urban variables are defined at the level of the surviving sister who responded to the survey and not at the level of the individual. This explains why those variables do not differ by gender. Table 2 confirms the results from the figures in a multivariate regression framework. The four panels display marginal effects of the coefficients in the above regressions where we have used different measures of educational achievement. We further present results for the entire sample (column 1) and separately for the urban (column 2) and rural (column 3) samples, considering the rural and urban location as of 1994. In column 4, we interact the urban and education variables. For the entire sample (column 1), the results indicate that, controlling for age, males and people with an educated and an urban background were more likely to die in 1994. Males were

Table 2: The Socio-economic Determinants of Mortality in 1994 in Rwanda Dependent Variable: Died in 1994

	(1) All	(2) Urban (1994)	(3) Rural (1994)	(4) All
Panel A: Education is measured by comparing primary education with no education				
Male	0.012 (0.005)**	0.007 (0.009)	0.015 (0.006)**	0.012 (0.005)**
Sister with at least some primary education	0.016 (0.009)*	0.023 (0.017)	0.012 (0.011)	0.014 (0.012)
Sister was living in an urban area in 1994	0.033 (0.008)***	–	–	0.027 (0.018)
Sister urban area in 1994* sister some primary	–	–	–	0.007 (0.019)
Panel B: Education is measured by comparing secondary education with lower schooling				
Male	0.012 (0.005)**	0.007 (0.009)	0.015 (0.006)**	0.012 (0.005)**
Sister with some secondary education	0.049 (0.016)***	0.038 (0.019)**	0.063 (0.023)***	0.066 (0.024)***
Sister was living in an urban area in 1994	0.029 (0.008)***	–	–	0.033 (0.010)***
Sister urban area in 1994* sister some secondary	–	–	–	−0.022 (0.019)
Total	44,532	17,717	26,813	44,532
Panel C: Education is measured by years of education				
Male	0.013 (0.005)***	0.007 (0.009)	0.015 (0.006)**	0.013 (0.005)***
Sister's years of education	0.004 (0.001)***	0.003 (0.002)	0.004 (0.002)**	0.004 (0.002)**
Sister was living in an urban area in 1994	0.030 (0.008)***	–	–	0.038 (0.015)**
Sister urban area in 1994* sister years of education	–	–	–	−0.002 (0.002)
Total	44,494	17,703	26,789	44,494
Panel D: Education is measured by comparing secondary and primary education with no education				
Male	0.012 (0.005)**	0.007 (0.009)	0.015 (0.006)**	0.012 (0.005)**
Sister with some primary education	0.009 (0.009)	0.016 (0.017)	0.006 (0.012)	0.007 (0.012)
Sister with at least some secondary education	0.057 (0.016)***	0.052 (0.025)**	0.068 (0.026)***	0.072 (0.027)***

(*continued on next page*)

Table 2: *Continued*

	(1) All	(2) Urban (1994)	(3) Rural (1994)	(4) All
Sister was living in an urban area in 1994	0.028 (0.008)***	–	–	0.027 (0.018)
Sister urban area in 1994* sister some primary	–	–	–	0.006 (0.020)
Sister urban area in 1994* sister some secondary	–	–	–	−0.017 (0.023)
Total	44,532	17,717	26,813	44,532

Marginal effects of logit regressions, dummies for age in 1994 included. The data are taken from the siblings' mortality data of the DHS, 2000, Rwanda. The data are weighted as recommended by the data provider, and adjusted to account for unequal probability of selection into the sample by a factor of 1/number of surviving females aged 15–49 in each family. When more than one respondent in the same household reports on the same sibship, only one respondent is randomly retained. The background of the family is derived from the characteristics of the sister who answered the survey. For sisters who never moved or moved for the last time before 1994, the actual location is recorded. Sisters who moved after 1994 are assumed to have been living in 1994 in the same type of location as the one reported, in 2000, as the previous one. Robust clustered standard errors between brackets. ***, **, *Significant at the 1, 5 and, 10% confidence interval, respectively.

around 1.2 percentage-points more likely to die, whereas individuals with an urban background are about 3 percentage-points more likely to die. Each of the four panels uses a different measure of education[2]: Panel A compares no education with at least some primary education (1.6 percentage-point more likely to die, significant at the 10% level), Panel B compares at least some secondary education (4.9 percentage-point more likely to have died) with lower educational achievements, Panel C enters linearly the years of education (each additional year of education increases by 0.4 percentage-point the probability to have died) and Panel D compares at least some secondary education[3] and some primary education with no education (only at least some secondary education is significant with a 5.7 percentage-point increase in death probability compared with no education). The conclusion from column 1 analysing the full sample, under the four specifications, is that the increase in mortality is especially strong for individuals whose sister had some secondary education.

Column 2 analyses the urban sample separately. It is interesting to notice that, in contrast with the overall sample and the rural sample, gender does not seem to be a significant predictor of mortality in 1994 in urban areas. While this is a somewhat surprising result, it is confirmed in all four different specifications and does not seem to be due to a lower sample size, given that the point estimates are very close to zero. It is worth remembering, however, that, as evidenced by the results from Table 2, column 1, and Figure 2, the mortality differential by gender is not very large (1.2 percentage-points) compared with the overall increase in mortality and it is also lower than the rural/urban differential (3 percentage-points). The minor difference in mortality by gender, in general, and in urban areas, in particular, reveals the genocidal nature of the violence in Rwanda, i.e., the intentional destruction of an entire group, man, women and children. Women were killed because of their biological role in reproduction and because their death would put the whole future of the ethnic group at stake.

In urban locations, education still predicts a higher mortality, especially when looking at secondary education in Panels B and D. The two other

[2] We also, as an additional robustness check, added the square of education to the regressions in Panel C, but in none of the four specifications (columns 1–4) was education squared significant.

[3] We did not include tertiary education as an education category as only 0.79% of surviving sisters had studied beyond high school.

measures, primary education (Panel A) or more and years of education (Panel C) have positive, but insignificant, coefficients, potentially because of the reduction in sample size. For the rural sample in column 3, gender predicts a higher mortality, with men more likely to die by 1.5 percentage-points. Education is also associated with higher mortality in the rural areas in 1994, even though in Panels A and D, for the some primary education category, the coefficient is not significant.

Column 4 tests whether the interaction between urban location in 1994 and education is significant. The interaction term is not significant in any of the four specifications, suggesting that the positive association between mortality during the genocide and educational status did not vary depending on the urban/rural location.

The multivariate regression analysis confirms the results presented descriptively: individuals living in urban areas and more educated were more likely to die in 1994 in Rwanda. The difference by education level is especially strong when comparing individuals whose sister had at least some secondary education with the rest of the population. The differences by educational background did not vary substantially whether the individuals resided in rural or urban areas. Interestingly, however, the higher mortality of men is only confirmed in the overall and in the rural samples, not in urban environments.

5 Conclusions

This paper uses the maternal mortality module in the Rwanda 2000 DHS to analyse how excess mortality during the 1994 genocide in Rwanda was distributed in the population. We find that adults, especially, males were most likely to die, indicating that violent deaths represented a large share of the excess mortality. Using the characteristics of the respondent sister as a proxy for the socio-economic status of the family, we also establish that individuals with an urban or educated background were more likely to die.

The 2000 DHS has one major drawback: it does not contain the ethnicity of the respondent. The ethnicity variable is determining the probability to die but we cannot include it in the analysis.[4] We note that Tutsis were not the only victims of the 1994 events. Educated (or richer) Hutus were also killed, both in the genocide as well as in the war with the RPF. The

[4] In an earlier version of this work (De Walque and Verwimp 2009), we proposed to use age at marriage as a proxy for the ethnic variable.

literature offers dramatic examples of this. Mamdami (2001) reports, for example, that, in order to escape killing, Tutsi girls '*had to dress and behave like peasants*' implying that the victims were also targeted based on class (rich vs. poor or urban vs. rural). Since our dependent variable captures all deaths in 1994, not just in the three months of the genocide, it includes all deaths in the genocide and the war (Tutsis as well as Hutus) as well as deaths by disease (e.g., in the refugee camps in Democratic Republic of Congo).

Despite the econometric problem of an omitted variable bias due to the absence of the ethnic variable in the 2000 DHS, which we acknowledge as a limitation of our study, we can conclude that the genocide disproportionately affected educated and urban groups and, therefore, compounding the lost lives and human tragedies, had a further impact in depriving Rwanda of its most skilled inhabitants. This is true independent of the omitted variable bias.

References

Akresh, R. and D. de Walque (2008) Armed Conflict and Schooling: Evidence from the 1994 Rwandan Genocide, World Bank Policy Research Working Paper 4606, Washington, DC: The World Bank.

André, C. and J.-P. Platteau (1998) 'Land Relations under Unbearable Stress: Rwanda Caught in the Malthusian Trap', *Journal of Economic Behaviour and Organisation*, 34: 1–47.

Bellows, J. and E. Miguel (2009) 'War and Collective Action in Sierra Leone', *Journal of Public Economics*, 93 (11–12): 1144–1157.

Boudreaux, K. (2009) 'Land Conflict and Genocide in Rwanda', *The Electronic Journal of Sustainable Development,* 1 (3): 85–95.

Bundervoet, T. (2009) 'Livestock, Land and Political Power: the 1993 Killings in Burundi', *Journal of Peace Research,* 46 (3): 357–76.

Chrétien, J.-P. (2000) *Afrique des Grands lacs : deux mille ans d'histoire*. Paris: Aubier.

De Lame, D. (1996) *Une Colline entre mille ou le calme avant la tempête, Transformations et Blocages du Rwanda Rural*. Tervuren, Belgium: Musée Royal de l'Afrique Centrale.

Département de Statistique Agricole (1984) Enquête Nationale Agricole (1984), Kigali, Rwanda.

Département de Statistique Agricole (1989–1991) Enquête Nationale Agricole (1989–1991), Kigali, Rwanda.

Des Forges, A. (1999) *Leave None to tell the Story*. New York: Human Rights Watch.

de Walque, D. (2005) 'Selective Mortality during the Khmer Rouge Period in Cambodia', *Population and Development Review,* 31 (2): 351–68.
de Walque, D. (2006) 'The Socio-demographic Legacy of the Khmer Rouge Period in Cambodia', *Population Studies,* 60 (2): 223–231.
de Walque, D. and P. Verwimp (2009) The Demographic and Socio-economic Distribution of Excess Mortality during the 1994 Genocide in Rwanda, World Bank Policy Research Working Paper 4850, Washington, DC: The World Bank.
Gakidou, E. and G. King (2006) 'Death by Survey: Estimating Adult Mortality without Selection Bias from Sibling Survival Data', *Demography,* 43 (3): 569–85.
Heuveline, P. (1998) "'Between one and three million': Towards the demographic reconstruction of a decade of Cambodian history (1970–79)", *Population Studies*, 52: 49–65.
Heuveline, P. (2001a) 'Approaches to measuring genocide: excess mortality during the Khmer Rouge period', in D. Chirot and M. Seligman (eds), *Ethnopolitical Warfare. Causes, Consequences and Possible Solutions*. Washington, DC: American Psychological Association.
Heuveline, P. (2001b) 'The demographic analysis of mortality crises: the case of Cambodia, 1970–1979', in H. E. Reed and C. B. Keely (eds), *Forced Migration and Mortality*. Washington, DC: National Academy Press.
Kalyvas, S. (2006) *The Logic of Violence in Civil War*. Cambridge: Cambridge University Press.
Mamdami, M. (2001) *When Victims Become Killers*. Princeton: Princeton University Press.
Newbury, C. (1988) *The Cohesion of Oppression: Clientship and Ethnicity in Rwanda, 1860–1960*. New York: Columbia University Press.
Prunier, G. (1995) *The Rwanda Crisis, History of a Genocide*. New York: University of Columbia Press.
Reyntjens, F. (1994) *L'Afrique des Grands Lacs en Crise*. Paris: L'Harmattan.
Verwimp, P. (2000) 'Development Ideology, the Peasantry and Genocide: Rwanda Represented in Habyarimana's Speeches', *Journal of Genocide Research*, 2: 325–61.
Verwimp, P. (2003a) 'The Political Economy of Coffee, Dictatorship and Genocide', *European Journal of Political Economy*, 19: 161–81.
Verwimp, P. (2003b) 'Testing the Double Genocide Thesis for Central and Southern Rwanda', *Journal of Conflict Resolution*, 47: 423–42.
Verwimp, P. (2004) 'Death and Survival during the 1994 Genocide in Rwanda', *Population Studies*, 58: 233–45.
Verwimp, P. (2005) 'An Economic Profile of Peasant Perpetrators of Genocide', *Journal of Development Economics*, 77: 297–323.
Verwimp, P. (2006) '"The One Who Refuses to Work Is Harmful to Society", Juvénal Habyarimana, 14 October, 1973', 1–31, available at http://www.hicn.org/papers/Habyarimana.pdf.