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The educational impact of shocks in utero: Evidence from Rwanda☆

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ABSTRACT

Research on the impact of violence and conflict on education typically focuses on exposure among a cohort of school-aged children. In line with the fetal origins hypothesis, this paper studies the long-run effect of exposure to adverse maternal health shocks while still in the womb. Exploiting the sudden and discrete nature of the Rwandan genocide and an identification strategy based on temporal and spatial variation, we find that the cohort *in utero* during the genocide reported on average 0.3 fewer years of schooling in the 2012 Rwanda. Population and Housing Census and was 8% points less likely to finish primary school relative to the cohort *in utero* just a couple of months later.

1. Introduction

There is concern among academics and practitioners that economic conditions or negative shocks in early childhood or even *in utero* may have persistent effects on health, education, and socioeconomic outcomes later in life (for reviews, see Godfrey and Barker (2000), Alderman and Behrman (2006) and Almond and Currie (2011)). In particular, the link between adult outcomes and shocks suffered while *in utero* has been popularized by Barker and James (1998). The Barker, or "fetal origins", hypothesis posits that stresses that impact development in the womb (such as maternal stress, malnutrition, and a range of other factors) can create long-term changes in biological functioning, impacting health outcomes throughout the lifetime. As a result, negative shocks affecting a fetus' health may lead to worse adult health, less cognitive achievement and human capital accumulation, lower productivity and wages, and higher mortality, particularly in low-income countries (Strauss and Thomas, 2008; Osmani and Sen, 2003).

A growing body of literature supports the long-run impact of shocks experienced in early childhood or *in utero*. Focusing on shocks experienced in early childhood, Lindeboom et al. (2010) find that poor macroeconomic conditions in infancy lead to higher mortality later in life in the Netherlands, Banerjee et al. (2010) that negative income shocks in early childhood lead to lower adult height in France, and Maccini and Yang (2010) that abundant early-life rainfall in Indonesia lead to higher educational attainment and wealth (assets) in adulthood. Alderman et al. (2006) show that preschool malnutrition has a negative impact on human capital formation in Zimbabwe, as measured by the number of grades completed, and Bundervoet et al. (2009) and Akresh et al., (2011) show that exposure to violence in early childhood is causally related to lower height-for-age z-scores several years later in Burundi and Rwanda, respectively. In an early groundbreaking study, Stein et al. (1975) find that the cohort *in utero* during the 1944/45 Dutch famine exhibited a range of negative health outcomes as adults. Almond (2006) shows that children who were *in utero* during the 1918 influenza pandemic had lower educational attainment, increased rates of physical disability, and lower socioeconomic status as adults relative to other birth cohorts. Similar results are found for the impact of *in utero* exposure to the Chinese famine between 1959 and 1961 (Almond et al., 2010).

Building on this literature, we examine the impact of *in utero* exposure to the Rwandan genocide on educational attainment 18 years later. Rwanda is among the countries with highest returns to education in the world and each additional year of schooling is associated with an estimated 22.4% increase in earnings (Montenegro and Patrinos, 2014). Education is therefore an

☆ The findings, interpretations and conclusions expressed in this paper are entirely those of the authors, and do not necessarily represent the views of the World Bank, its Executive Directors, or the governments of the countries they represent.

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important human capital in Rwanda. The impact of the genocide in Rwanda on schooling has been examined before, but focused on children who were of schooling age when the violence erupted. Akresh and De Walque (2011) use two cross-sectional DHS rounds bracketing the genocide (the 1992 and 2000 rounds) and find that primary school-aged children exposed to genocide experienced a drop in educational achievement of almost one-half year of completed schooling. Using pre- and post-genocide census data, Guariso and Verpoorten (2015) find a larger effect, with school-aged children exposed to genocide achieving on average one year less of education and the impact being particular large (and negative) for girls. In contrast to the Akresh and De Walque findings, Guariso and Verpoorten (2015) do not find an impact of the spatial variation in genocide intensity: education of school-aged children in areas with high genocide intensity did not suffer more than that of school-aged children in lower intensity areas. The authors hypothesized that this could have been due to a nationwide decrease in availability of teachers, as many teachers were either Tutsi or moderate Hutu and therefore targeted during genocide, or a decrease in government expenditures on education during genocide. In the end, what mattered was being of school age during the genocide, not where you resided at the time.

In this article we focus on exposure to the genocide *in utero*. It is well known that shocks to maternal health or maternal malnutrition during pregnancy negatively affect the health of offspring, an effect that partly runs through low birth weight (see, for instance, Almond, 2006; Almond and Currie, 2011; McCormick, 1985; Mulmi et al., 2016; Osmani and Sen, 2003; Painter et al., 2005; Stein et al., 2004). As health is strongly related to cognitive abilities (Guven and Lee, 2015), we expect fetal exposure to the genocide to manifest in worse educational attainment in adolescence. Using data from the 2012 Rwanda Population and Housing Census (PHC), we find that children who were *in utero* during the genocide were not less likely to ever be in school, but were approximately 8% less likely to complete primary school, and on average achieved 0.3 fewer years of education compared to children who were born a couple of months later (who were *in utero* immediately after the genocide). The effect is robust for a battery of robustness and sensitivity checks. Restricting the sample to children who were *in utero* during the genocide, we find evidence for a "continuous" treatment effect, with children who spent more months *in utero* during the genocide achieving less education relative to children who were in the womb only towards the end of the genocide.

In line with Guariso and Verpoorten (2015), we do not find an effect of spatial variation in the intensity of the genocide: 18 years after the genocide, children who were *in utero* during the events had attained less education, irrespective of the intensity of the genocide in their place of birth. These findings suggest that the negative effects of the genocide were felt nationwide. The negative effect of exposure is larger for girls: girls exposed to the genocide while *in utero* attained approximately 0.4 fewer years of education compared to girls born just a couple of months later, with a smaller effect of 0.2 fewer years of education found for boys. This finding corroborates with research results in other contexts (see *e.g.* Dagnelie et al., 2014) and suggests that stress experiences in the womb, such as those induced by conflict, are more fatal for male fetuses.

By studying the effects of *in utero* exposure to violence, this article contributes to two strands of literature. First, the findings confirm the fetal origins hypothesis that stresses suffered while *in utero* have consequences that persist throughout life. Second, the findings add to the literature on the impact of violence and armed conflict on education (see Justino (2011) for a comprehensive review) by considering exposure *in utero* as opposed to exposure at schooling age, which is typically done (see –next to the articles already mentioned- Akbulut-Yuksel (2014), Gainmarco (Fransen et al. (2016), Leone and Salardi (2014), and Shemyakina (2011)).[1] This paper proceeds as follows: The next section sketches the empirical setting and presents the descriptive statistics. Section 3 focuses on identification, while Section 4 presents the main results and sensitivity checks. Section 5 concludes.

2. Empirical setting and data

2.1. The setting: the 1994 Rwandan genocide

This paper focuses on Rwanda, a small and densely populated country in Eastern Africa (see the Annex for a geographical overview). Rwanda's history is characterized by continuous tensions between the country's two main ethnic groups, the Hutu and the Tutsi. Under Belgian colonial administration (World War II until Independence in 1962), the Tutsi minority group was privileged in all aspects of economic and political life. After independence the Hutu took over power and firmly established a one-party state. Violence against the Tutsi had already started in 1959 and sporadically flared up in the decades following independence, swelling the number of Tutsi living in exile, mainly in neighboring Uganda. In 1990, the Rwanda Patriotic Front (RPF), a rebel army founded by Tutsi refugees, invaded Rwanda from the North, leading to a period of intermittent localized warfare and negotiations with the Rwandan government until a peace agreement was reached in 1993.

Following the shooting down of the plane of president Habyarimana in the evening of April 6, 1994, extremist Hutu militias (mainly the *Interahamwe*), the Rwandan Armed Forces (FAR) and police forces mobilized the civilian Hutu population in a campaign to annihilate the Tutsi minority, and, to a lesser extent, moderate Hutus who opposed the mass killings. In the three months between the beginning of April and the beginning of July 1994, an estimated 500,000 to 1,000,000 people were massacred, amounting to between 7 and 14% of the then total population (Des Forges, 1999). An estimated 75% of the Tutsi population was killed (Prunier, 1995; Verpoorten, 2005). The RPF, which had resumed its operations following the start of the genocide, took control of the country by end of June 1994 and largely put an end to the ethnic cleansing of Tutsi. The takeover by the RPF was followed by a mass exodus of refugees, mainly Hutu fearing RPF reprisals, to neighboring countries. It is estimated that more than 2 million Rwandans fled to DRC and Tanzania in the wake of the genocide.

Next to the tremendous loss of life, the genocide also had severe socioeconomic consequences. GDP declined by 50% in 1994, and it was not until 1999 that GDP had recovered to its pre-genocide (1993) level. Poverty in 1997 was estimated at 70%, up from 53% in 1993 (World Bank, 1998). Agricultural production plummeted during genocide (and recovered to pre-genocide levels by 1998), household cattle stocks halved (Verpoorten, 2009), health indicators deteriorated, and food insecurity and malnutrition were rife (World Bank, 1998).

2.2. Data overview

Our analysis measures the impact of genocide exposure while *in utero* on educational achievement 18 years later. The main source of data for the analysis is the 2012 Population and Housing Census (PHC), implemented between August 16 and August 30, 2012. The

[1] One notable exception is Leon (2012), who examines the impact on education of conflict exposure (in Peru) at different stages in life and finds that exposure to conflict in utero is causally related to lower educational attainment.