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Intergenerational Impact of Population Shocks on Children's Health

Evidence from the 1993–2001 Refugee Crisis in Tanzania

Soazic Elise Wang Sonne
Paolo Verme

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Abstract

This paper examines how parents' early childhood exposure to a refugee crisis impacts their children's health status. Based on Demographic and Health Survey data from Tanzania with the migration history of mothers and fathers, the analysis exploits geographical, time, and cohort variations using shock intensity and distance from refugee camps to instrument treatment. The findings show that children who were born to parents who were living closer to refugee camps during their early childhood have lower height for their age and are more likely to be stunted. The results are robust to alternative functional forms of the distance from camps, alternative specifications of the treatment and control groups, alternative cohorts of mothers, and several placebo tests.

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Intergenerational Impact of Population Shocks on Children's Health: Evidence from the 1993-2001 Refugee Crisis in Tanzania

Soazic Elise Wang Sonne[1] *and Paolo Verme*[2]

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[1] World Bank and United Nations University-Maastricht Economics and social Research Institute and Training Center on Innovation and Technology (UNU-MERIT).

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1. Introduction

Do parents' early childhood exposure to refugee shocks impact their children's health outcomes? This paper addresses this question by looking retrospectively at the 1993-2001 refugee crisis in Northwestern Tanzania and studying the likelihood of stunting for children born to mothers who lived through the refugee crisis during their early childhood.

Early childhood exposure to economic and political shocks is known to have persistent and long-lasting adverse consequences in adulthood and across generations (Alderman et al., 2006; Currie, 2009; Almond et al., 2005; Maluccio et al., 2009; Almond and Currie, 2011; Shah and Steinberg, 2013). In a recent paper, Akresh et al. (2018) provide evidence of the intergenerational impact of conflict exposure on children born to women who were directly exposed to the 1967-1970 Nigerian Civil War. They found that exposure of mothers to civil war had an adverse impact on child growth, survival, and education. In a similar study, Tafere (2016) found that children born to mothers who were exposed to the 1983-85 Ethiopian famine in their first 3 years of life have poor health status, lower schooling achievement and perform poorly in standardized tests.[3] Cook et al. (2018) use representative survey data from the United States and found evidence of a multigenerational effect of in-utero exposure to the 1918 influenza pandemic on education, economic, and health outcomes of the children and grandchildren of those affected. Likewise, Caruso (2017) investigates the long-term and intergenerational effects of childhood exposure to natural disasters that occurred in Latin America 100 years ago. He finds that children who were in utero and young at the time of the natural disasters are less likely to accumulate human and physical capital in adulthood (they have worse health and fewer assets). Most importantly, he finds evidence of an intergenerational transmission of the shock, indicating that children of mothers who have been exposed to natural disasters achieved fewer years of education. Caruso and Miller (2015) find similar results for the 1970 Ancash earthquake in Peru. Using the 1993 and 2007 Peruvian census data, their study reveals that both males and females affected by the shock in utero respectively complete 0.5 and 0.8 less years of education in adulthood as compared to those not affected by the shock. In addition, evidence of an intergenerational transmission of the shock was found with children of exposed mothers at birth completing 0.4 less years of education. Comparable findings emerge from Northeast Tanzania where Caruso (2015) found that children of women affected by the 1993 flood in the Tanga region before the age of 18 present lower Height-for-Age Z scores (HAZ) as compared to unexposed adjacent cohorts.

The question of whether refugee crises are beneficial or detrimental to the socio-economic well-being of host communities is a topic that has attracted substantial interest only in recent years and the evidence

[3] Peabody Picture Vocabulary Test (PPVT).

is still limited to few and mostly short-term outcomes. A recent review of this literature finds that the probability of finding a negative and significant effect on household well-being among the host population is less than 20% and less than 30% if we consider employment or wage outcomes (Verme and Schuettler, 2019). The review also finds some evidence that negative effects tend to disappear over the long-term and are mainly associated with larger crises. However, the evidence on household well-being is still scarce and most authors have focused on labor market outcomes in the short and medium-term, largely ignoring outcomes in other domains and the intergenerational effects generated by forced displacement shocks. Studies measuring the impacts of refugees on households in host communities are relatively few, but rather consistent in finding growth in consumption over the short and medium-term (Alix-Garcia and Saah, 2010; Ruiz and Vargas-Silva, 2015, 2016; Del Carpio and Wagner,2015; Rozo and Sviastchiy, 2018). Similar research focusing on a narrower set of outcomes, such as employment and wages, finds different results depending on the country context and the population studied. The literature investigating the short and long-term effects of refugee influx concord that negative outcomes tend to disappear in the long-run (Del Carpio and Wagner, 2015; Ceritoglu et al., 2017; Peri and Yasenov, 2019). Overall, the review highlights the importance of extending research beyond the consumer and labor market outcomes and beyond the short and medium-term.

Few studies have empirically investigated the short or long-run socio-economic impacts of refugee shocks on children's health, providing some initial but inconsistent evidence. On the one hand, one might believe that the positive impacts induced by the sudden arrival of refugees on host communities (increased demand for economic goods, humanitarian assistance, improved infrastructure, increased agricultural production[4]) might translate into better health care services and consequently positive children's health outcomes. On the other hand, most studies have reported negative changes in welfare among host communities following refugees' arrival. Disease outbreaks (Kibreab, 1985), competition over natural resources and paid jobs, environmental damage, criminality and pressure on basic service delivery in schools and hospitals are among the most cited negative impacts of refugees on hosts. These could trigger poorer health, education and labor market outcomes of the first but also the second generation of children born years after the crisis.

Baez (2011) uses secondary data from Tanzania and finds that, as compared to children living in areas not affected by refugees, children living in host communities have a higher incidence of infectious diseases, are more likely to die before the age of 5 and have a reduced stature (height) with an acute effect found for younger cohorts. However, building on Baez's study, Mabiso et al. (2014) find no

[4]Bharadwaj and Mirza (2019).

lasting impacts for children living in receiving areas, whereas Maystadt and Verwimp (2014) find a limited but positive impact of refugees on health outcomes, driven by the improvement of infrastructure including health services in refugees' hosting areas. We are not aware of studies that looked at the intergenerational health effects of refugee crises on children in Tanzania or elsewhere.

This paper intends to contribute to the relatively small but growing literature on the long term and intergenerational impacts of early childhood exposure to shocks by expanding this literature to refugee crises. We empirically examine and hypothesize that the already documented health impacts of early life shocks such as natural disasters, famine, war or pollution on the second generation of children also hold for temporary population shocks such as a refugee influx. More specifically, we study if Tanzanian children born to parents who spent their early childhood in high refugee-receiving areas are more likely to be stunted. We focus on under five years old Height for Age Z score (HAZ) and the probability of stunting as our key health indicators. This choice stems from the critical role of these measures in capturing long-term health effects and socio-economic development prospects along the life course.

The paper finds that children of mothers exposed to the 1993-2001 refugee crisis in Northwestern Tanzania are more likely to be stunted. We use the latest geocoded 2015-2016 Tanzanian Demographic and Health Survey (DHS) capturing migration histories of mothers and fathers. Our results suggest that, almost 15 years after refugees' arrival, under five years old children born to mothers who were between 0 and 5 years old during the refugees' influx (1993-2001) and living closer to refugee camps have lower Height-for-Age Z-scores and are more likely to be stunted than a comparable sample of children whose mothers were more than five years old at the time of the shock. We also find that mothers who were in-utero and less than 24 months at the time of the high refugee influx period from 1993 to 1996 are more likely to give birth to children who are stunted. No differentiated impacts were found between girls and boys.

Several plausible mechanisms explain our main results. We found that early childhood "refugees-exposed" mothers are less likely to complete secondary education in their adulthood. Our results also show that those mothers have a lower likelihood of land and house ownership more than a decade after refugees' arrival. Most importantly, our findings reveal higher participation in the labor market of grandmothers of children who were living in refugees' receiving areas at the time of the influx, potentially suggesting a trade-off with child care at home, especially for girls. This corroborates findings from Alvi and Dendir (2011) who reported that earlier-born girls are more likely to perform domestic work in Ethiopia. Our results are in line with findings emanating from recent studies showing that the long-term consequences of shocks are more pronounced among females than males (Zhibo et al.,2015;

Almond et al., 2010). In fact, any form of physiological and nutritional stress encountered by girls when they were in utero or in the first 36 months of their lifetime may undermine their growth, which, in turn, translates into poorer anthropometric health and learning outcomes of their offspring (Osmani and Sen, 2003).

Overall, this paper makes a two-fold contribution to the literature on the impacts of refugee shocks on host communities. First, it provides a novel contribution to the sparse literature on the long-term legacy of temporary population shocks experienced during the first five years of life. It examines how the direct positive or negative impacts of refugees on parents living in host communities at the time of the influx carry over to the next generation of under five years old children born more than a decade after refugees' arrival. Second, it unpacks the aggregate impacts previously found on human capital accumulation by highlighting differential effects across age cohorts as opposed to effects across occupations (Maystadt and Verwimp, 2014), or sectors (Del Carpio and Wagner, 2015 Ruiz and Vargas-Silva, 2016).

The remainder of the paper is laid out as follows. Section 2 describes the context and background surrounding the refugee crisis in Northwestern Tanzania. Section 3 presents a theoretical framework underpinning the intergenerational transmission of population shocks. Data are discussed in section 4. Section 5 focuses on the empirical strategy, including several placebo tests for robustness checks. Section 6 provides preliminary statistical tests, the main econometric findings, and robustness tests and some leads on possible explanations of the results. Section 7 concludes the paper.

2. Background

Over the past decades, the global number of forcibly displaced people has significantly increased, reaching more than 70.8 million in 2018, the highest figure in 70 years. One of the key features of the forced displacement crisis of the past few decades has been its regional focus, with almost 90% of refugees and IDPs living in developing countries. More than one-third of forcibly displaced people live in Africa. Sub-Saharan Africa hosts more than 26% of the world's 26 million refugee population (UNHCR, 2019).[5] The region alone saw a threefold increase in the number of forced migrants between 1970 and the early 2000s (Baez, 2011), mainly due to the rise in civil and regional conflicts, particularly in Central and Eastern Africa. Following the escalation of violent conflicts in neighboring Burundi, Rwanda, South Sudan and the Democratic Republic of Congo during the 1993-1994 bloodiest period of civil wars, Tanzania was flooded by hundreds of thousands of refugees seeking peaceful shelter. By

[5] UNHCR Population Statistics, www.popstats.unhcr.org.

the end of 1994, the country, known for its hospitality and open-door policy,[6] hosted almost 1.3 million people in its Northwestern region, becoming one of the top four refugee receiving countries in Africa.[7]

The sharp growth in refugees experienced by Tanzania between 1993 and 1996 was a direct consequence of several dramatic events that occurred in short succession in neighboring countries. On October 21, 1993, the assassination of the Burundian President Melchior Ndadaye and the ethnic clashes that followed led to almost 300,000 Burundians seek refuge in the Kigoma region of Western Tanzania. Shortly after, on April 6, 1994 the Burundi and Rwanda presidents Cyprien Ntaryamira and Juvenal Habyarimana died in an airplane crash, prompting the Rwandan genocide and resulting in a sudden outflow of nearly 250,000 Rwandans refugees in the Northwestern regions of Tanzania, particularly the Kagera region. Rwandans continued to flee their country over the following years and, by early 1995, nearly 600,000 refugees from Rwanda were living in Tanzania. The aftermath of the Rwanda genocide and the spillover of the Burundian conflict also led to the first Congo civil war from October 1996 to May 1997, resulting in almost 500,000 Congolese refugees settling in Northwestern Tanzania. This would be followed by a second wave of refugees arriving in 1999 after the second Congo war. [8]

As a consequence of these events, Tanzania has hosted very high numbers of refugees for almost a decade, between 1993 and 2001, with a peak around 1994[9] (see Figure A4 in Annex A). The UNHCR and the Tanzania Ministry of Home Affairs decided to settle most of these refugees in temporary camps located within 40 km from the border and at a short distance from Tanzanian villages. Refugees were finally settled in 13 main camps[10] covering the Karagwe, Ngara, Kasulu, Kigoma and Kibondo clusters in Nortwestern Tanzania (Figure A1). With a population of 2.5 million people, this massive human displacement led to an increase of the population in the two host regions (Kagera and Kigoma) by over 50%. In some clusters, refugees outnumbered Tanzanians five to one (Whitaker, 2002) and by the end of May 1994, Benaco refugee camp located in Ngara cluster (Kagera region) was the largest in the world (see tables A1, A2 and figures A5, A6 in Annex A). This forced displacement crisis has been recently ranked as the largest in modern history in terms of share of refugees over the local population (Verme and Schuettler, 2019). The magnitude of such a sudden population shock was most likely to bring a profound change in the livelihood and economic activities of the hosts.

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[6] See Runtinwa (2006) and Milner (2013).

[7] The country was ranked first in 1998 and 1997; third in 1996, second in 1995 and 1994 and fourth in 1993 (UNHCR Statistical overview, 1998).

[8] The second Congo civil war lasted 4 years, 11 months, 2 weeks and 2 days from August 1998 to 18 July 2003.

[9] By the end of 1996, most refugees from Rwanda had been repatriated, whereas Burundian refugees were sent home over a longer period of time, at least until 2004, due to the continued instability in their country of origin.

[10] Benaco, Burigi, Chabalisa, Kagenyi, Keza, Lukole A, Lukole B, Kitalli, Mbuba, Musuhura, Mwisa, Omukariko and Rubwera.

Several studies have measured the impact of the 1993-2001 refugee inflow in Northwestern Tanzania on host communities. In line with other similar studies, they find a general positive effect on household well-being with asymmetric employment effects across population groups. Maystadt and Verwimp (2014) found that doubling the refugee presence increased the per adult equivalent consumption of hosts by 6-8 percent. Maystadt and Duranton (2018) found that all types of local workers gained from the refugee presence, although positive effects were mainly noticed for agricultural workers and the self-employed in non-agricultural activities. Similarly, Ruiz and Vargas-Silva (2015) found a negative impact on employees overall but a positive and significant impact on professionals and government employees. Ruiz and Vargas-Silva (2016 and 2017) found that the forced migration shock led to an increase in the likelihood of Tanzanians working outside the household as caretakers and a lower likelihood of working outside the household as employees, particularly agricultural employees. They also found that young and less educated women benefitted from employment opportunities but were less likely to engage in non-domestic employment. Several qualitative studies reported that the 1993-2000 refugee influx in Northwestern Tanzania created both winners and losers among local hosts (Whitaker, 1999 and Waters,1999).

These latter studies also shed some light on the mechanisms that can help explain such outcomes either in the short or long run. According to Landau (2004), there are two main economic and structural changes that refugees brought to Western Tanzania: price distortions and temporary employment opportunities. As refugees progressively arrived during the 1993-2001 period, millions of dollars flew into the affected areas every week in the form of international relief programs. While the proliferation of NGOs and humanitarian agencies created a wide range of labor market opportunities for the hosts, the improvement of infrastructure and transport systems raised the demand for basic goods and services, resulting in inflation (Waters 1999, Whitaker 1999). Before the arrival of refugees in the Kagera and Kigoma regions, the government was the main provider of formal jobs. During the influx, employment opportunities for Tanzanian hosts ranged from direct full-time jobs to secondary types of employment (domestic help) with humanitarian agencies. Fieldwork[11] completed by Landau (2004) in the Kasulu cluster of Kigoma found that only 1 out of 52 villagers was engaged in full-time employment with a refugee-related organization because of the low level of formal education among the hosts, suggesting that most of the jobs created were low skilled, part-time or informal. [12] Men and women located closer to refugee camps were more likely to be hired as domestic workers (security guards, cooks, washers,

[11]The fieldwork consisted of 90 intensive interviews (44 in Mpwapwa, 52 in Kasulu) across six sites (four villages and the district capitals).
[12] This includes knowledge of the English language but also functional, numeracy, literacy, basic computing and accountancy skills.

cleaners, etc.) for foreign employees. On the other hand, the cheap but illegal[13] labor force provided by refugees to the hosts improved cash crop production (Landau, 2004).[14]

Based on qualitative interviews undertaken by Whitaker (2002) at the time of the refugee crisis in 1995, many employees previously working with hospitals, schools and other governmental organizations decided to leave their jobs in quest of a higher salary with international relief organizations. More specifically, in the Ngara cluster in Northwestern Tanzania where the population of refugees was more than twice the number of Tanzanians in 1994 (see Tables A1 and A2; Figures A5 and A6 in Annex A). It was reported that more than 50 percent of the health center staff and 35 percent of dispensary workers had left their government jobs to work with relief agencies. This massive desertion of public schools and hospitals in favor of international humanitarian organizations has obviously affected the short and long-run human capital outcomes of children who were still in their early age at that time.

Tanzanian schools located at the border with Rwanda, Burundi and the Democratic Republic of Congo were substantially damaged, as some refugees sheltered in classrooms upon their arrival and, in some instances, used desks as firewood for cooking and heating, while school latrines became rapidly filled. In 13 schools in one of the most affected clusters (Ngara), 72 classrooms, 757 desks, 68 latrines, 31 chairs, 10 doors and 36 windows were damaged (Mwakasege, 1995).

The performance of students was also significantly affected by the refugee presence, as lessons were disrupted. At the demand of village leaders and relief organizations, the majority of teachers became involved in the registration of refugees, hence dedicating less time to teaching their lessons at schools for relatively longer periods of time, varying from 2 to 7 weeks (Mwakasege, 1995). Due to several factors, including among others the willingness of both teachers and students to reap the benefit of petty businesses flourishing around the camps, the performance of students during the influx period from 1993-1995 was significantly reduced. Mwakasege (1995) warned against the long-term implications of these disruptions on educational performance in refugee areas already during the crisis.

Local health facilities also became quickly overburdened and, by December 1994, drug shortages were observed in several hospitals. This was the case especially in dispensaries in the Kasulu cluster (Kitanga and Kilelema villages). Despite the health care services back-up of humanitarian agencies, the supply in medicines significantly dropped after the refugees were moved into camps. In several hospitals in

[13] This mainly has to do with the 3km perimeter set by the government preventing and restricting refugees living in camps to fully engage in employment activities with the local Tanzanian population.
[14] This information was obtained by Landau from an interview conducted on December 12, 1999 with the Deputy Director of the Kasulu District Development Program.

Tanzania, it was reported that refugees were occupying more beds than hosts (Whitaker, 2002). Despite the massive resources mobilized by NGOs, Tanzanian hosts were not given priority access to health care services and several cases revealed that some clinics were accepting Tanzanians only as out-patients or were simply refusing to give them medical treatment whenever the health supplies were low (Whitaker, 2002). This might have had an obvious negative impact on under five years old children's health outcomes.

Overall, the quantitative and qualitative evidence presented above is consistent in finding a general positive effect on local households' well-being during the crisis and increased employment opportunities. However, these positive developments have been accompanied by a reallocation of labor away from primary health care and education services and towards low-skilled services to the aid community during a period characterized by increased demand for these services and a general downgrading of schools and health centers. These factors combined have likely resulted in an intra-household reallocation of labor, with increased demands on women and possibly negative effects on child care. Therefore, we should expect children to have suffered from a combination of decreased standards in education, health care and home care services.

3. Theoretical Framework

To understand how temporary population shocks experienced by parents might extend into the next generation of children, we use the dynamic model of human capital accumulation proposed by Cunha et al. (2006), Cunha and Heckman (2007) and Cunha et al. (2010).[15] The Human Capital (HC) vector at a time t, is made of a combination of cognitive skills c, non-cognitive skills n and health capabilities h as follows:

$$HC_t = (HC_{ct}, HC_{nt}, HC_{ht}) \quad (3.1)$$

Each of those skills are said to be "dynamically" self-reinforcing, implying that a higher stock of human capital in one period leads to a higher stock of human capital in the subsequent period. In other words, skills acquired at a specific period of life serve as inputs at a later stage. This is also known as *self-production* in the model. Depending on the specific age period over the life course, any shock ω might either enhance or reduce the stock of skills affecting the self-production process. The early childhood development literature distinguishes two critical periods along the life course: In utero and 0-3 years of

[15] Note that this paper does not test the Cunha and coauthors theory. The model is presented to provide the framework and justification for the econometric analysis across cohorts presented in the results section.

age. According to Cunha and Heckman (2007) and Cunha et al. (2010), the technology function for human capital accumulation is given by:

$$HC_{k,t+1}=f_k(\ HC_t, I_t, HC_p, \mathrm{w}_t) \tag{3.2}$$

where $k \in \{c, h, n\}$ is the set of skills, $HC_{k,t+1}$ is the stock of any skills k at time $t+1$, I_t is the level of parental investments in children at time t, HC_p is the level of parental endowment and w_t is the shock encountered by parents at time t. The recursive solution of the model above allows it to be rewritten as follows:

$$HC_{k,t+1}=f_k(\ HC_0; I_0, I_1, I_2, \dots., I_t; HC_p; \mathrm{w}_0, w_1, \dots \dots \dots \mathrm{w}_t) \tag{3.3}$$

In other words, the stock of human capital or skills of the child at time t depends on his/her initial level of human capital HC_0 which is predetermined by congenital factors and the socio-economic environment; parental investments at different periods of the life cycle t $(I_0, I_1, I_2, \dots., I_t)$; parental endowment HC_p but also shocks encountered at different stages of the life cycle ($w_0, \dots \dots \dots w_t$). In our case and for the sake of simplicity, we focus on early childhood defined as age 0 to 5 and corresponding to *t*=0 and late childhood defined as age 6-16 and corresponding to *t*=1. The stock of human capital in late childhood could then be defined as:

$$HC_{k,1}=f_k(\ HC_0, I_0, HC_p; \mathrm{w}_0). \tag{3.4}$$

Knowing that parental investments and endowments are both endogenous, $I_{k,0}=g_k(\ HC_0, HC_p; \omega_0)$ and $HC_p = HC_{\mathrm{p},2} = q(HC_{\mathrm{p},1}, I_{\mathrm{p},1}, HC_g, w_{\mathrm{p},1})$, with $HC_{p,1}= q(HC_{\mathrm{p},0}, I_{\mathrm{p},0}, HC_g, w_{\mathrm{p},0})$, where HC_g is the level of parental endowment at childhood, the effect of parents' early childhood shock on their offspring's human capital can therefore be described as:

$$\frac{\partial HC_{k,1}}{\partial w_0^p} = \frac{\partial HC_{k,1}}{\partial I_0}\frac{\partial I_0}{\partial HC_p}\frac{\partial HC_p}{\partial w_0^p} + \frac{\partial HC_{k,1}}{\partial HC_p}\frac{\partial HC_p}{\partial w_0^p} = \frac{\partial HC_p}{\partial w_0^p}\left(\frac{\partial HC_{k,1}}{\partial I_0}\frac{\partial I_0}{\partial HC_p} + \frac{\partial HC_{k,1}}{\partial HC_p}\right) \tag{3.5}$$

However, $\frac{\partial HC_p}{\partial w_0^p} = \frac{\partial HC_p}{\partial HC_1^p}\frac{\partial HC_1^p}{\partial w_0^p} + \frac{\partial HC_p}{\partial I_1^p}\frac{\partial I_1^p}{\partial HC_1^p}\frac{\partial HC_1^p}{\partial w_0^p} = \frac{\partial HC_1^p}{\partial w_0^p}\left(\frac{\partial HC_p}{\partial HC_1^p} + \frac{\partial HC_p}{\partial I_1^p}\frac{\partial I_1^p}{\partial HC_1^p}\right)$ with $\frac{\partial HC_1^p}{\partial w_0^p} = \frac{\partial HC_1^p}{\partial w_0^p} + \frac{\partial HC_1^p}{\partial I_0^p}\frac{\partial I_0^p}{\partial w_0^p}$. Therefore,

$$\frac{\partial HC_p}{\partial w_0^p} = \left(\frac{\partial HC_1^p}{\partial w_0^p} + \frac{\partial HC_1^p}{\partial I_0^p}\frac{\partial I_0^p}{\partial w_0^p}\right)\left(\frac{\partial HC_p}{\partial HC_1^p} + \frac{\partial HC_p}{\partial I_1^p}\frac{\partial I_1^p}{\partial HC_1^p}\right). \tag{3.6}$$

Finally, the impact of parents' late childhood shock on their children's human capital is given by

$$\frac{\partial HC_{k,1}}{\partial w_0^p} = \left(\frac{\partial HC_{k,1}}{\partial I_0}\frac{\partial I_0}{\partial HC_p} + \frac{\partial HC_{k,1}}{\partial HC_p}\right)\left(\frac{\partial HC_1^p}{\partial w_0^p} + \frac{\partial HC_1^p}{\partial I_0^p}\frac{\partial I_0^p}{\partial w_0^p}\right)\left(\frac{\partial HC_p}{\partial HC_1^p} + \frac{\partial HC_p}{\partial I_1^p}\frac{\partial I_1^p}{\partial HC_1^p}\right) \tag{3.7}$$

which can be decomposed as follows:

$$\frac{\partial HC_{k,1}}{\partial w_0^p} = \overbrace{\left(\frac{\partial HC_{k,1}}{\partial HC_p}\frac{\partial HC_p}{\partial HC_1^p}\frac{\partial HC_1^p}{\partial w_0^p}\right)}^{A} + \overbrace{\left(\frac{\partial HC_{k,1}}{\partial I_0}\frac{\partial I_0}{\partial HC_p}\frac{\partial HC_p}{\partial I_1^p}\frac{\partial I_1^p}{\partial HC_1^p}\frac{\partial HC_1^p}{\partial I_0^p}\frac{\partial I_0^p}{\partial w_0^p}\right)}^{B} + \tag{3.8}$$

$$\overbrace{\frac{\partial HC_1^p}{\partial w_0^p}\left[\frac{\partial HC_{k,1}}{\partial I_0}\frac{\partial I_0}{\partial HC_p}\left(\frac{\partial HC_p}{\partial HC_1^p} + \frac{\partial HC_p}{\partial I_1^p}\frac{\partial I_1^p}{\partial HC_1^p}\right) + \frac{\partial HC_{k,1}}{\partial HC_p}\frac{\partial HC_p}{\partial I_1^p}\frac{\partial I_1^p}{\partial HC_1^p}\right] + \frac{\partial HC_1^p}{\partial I_0^p}\frac{\partial I_0^p}{\partial w_0^p}\left[\left(\frac{\partial HC_{k,1}}{\partial I_0}\frac{\partial I_0}{\partial HC_p} + \frac{\partial HC_{k,1}}{\partial HC_p}\right)\frac{\partial HC_p}{\partial HC_1^p} + \frac{\partial HC_{k,1}}{\partial HC_p}\frac{\partial HC_p}{\partial I_1^p}\frac{\partial I_1^p}{\partial HC_1^p}\right]}^{C}$$

Following Cunha and Heckman (2007), A is known as "*self-productivity*". It refers to the fact that parents' early life exposure to shocks reduces their own stock of human capital endowments, which then affects their offspring's level of human capital. B is known as "*dynamic complementarity*". It embodies the idea that parental early life exposure to shocks decreases the level of their human capital's return on investments and consequently their human capital endowments (stock of skills). This then translates into a low level of human capital for their offspring. C is a mixed channel.

If the above theoretical framework has the ability to unpack the mechanisms by which an intergenerational impact of a temporary population shock might occur, the magnitude and the direction of such an impact are not clear. This could only be investigated with an empirical analysis with historical data on refugees' geolocation but also parent's socio-economic characteristics and children's health in host communities.

4. Data

We use the 1991, 1996 and 2015/2016 data from the Tanzania Demographic and Health Survey (DHS). These are nationally representative repeated cross-section surveys providing information on under 5 years old children's anthropometric measures and mothers' and fathers' demographic and socio-economic characteristics. Our main anthropometric outcome of interest most likely to be impacted by parents' exposure to refugee shock in the long-run is the Height for Age Z score (HAZ). Together with stunting defined as a HAZ score below -2 SD, the WHO considers this indicator as a marker of a deficient nutritional environment in early childhood and a predictor of future well-being in adulthood. More specifically, stunting is associated with poor birth outcomes, lower labor market participation, lower earnings, higher incidence of infectious diseases and lower cognitive ability (Case and Paxson 2008, 2010; Bhalotra and Rawlings 2011; Leroy and Frongillo 2019). The HAZ or Standard Deviation (SD) score reflects the cumulative linear growth of the child and is defined as follows:

$$HAZ_{ia} = \frac{H_{ia} - m_a^r}{\sigma_a^r}$$

where H_{ia} is the height of the child i in the age or sex group a ; m_a^r is the median of children's height for individuals of the same age/sex group in the WHO reference population and σ_a^r is the standard deviation of children's height of the same age/sex group in the reference population. Z-scores below -6SD and above 6SD are considered by the WHO as biologically implausible values (0.5% or 49 children out of 10,233 in our sample are presenting such abnormal anthropometric measures and are therefore removed from our analysis). An under five years old is defined as severely stunted if the HAZ score is lower than -3 SD. In our sample, 29.8% of children are stunted and 9.8% are severely stunted.

DHS surveys also include information on labor market participation, wealth, years of education, land/house ownership, and decision-making on health care of mothers and fathers. These are variables that can be used to test for alternative predictors of children's stunting. They can also be used to test for mechanisms and channels of transmission of the refugee shock on less than five years old children's HAZ or the probability of stunting. Table A3 in the annex provides all definitions of the variables used in the paper.

For our main intergenerational analysis, we use the latest 2015/2016 DHS survey of Tanzania collected between August 2015 and February 2016 with migration history of mothers and fathers and information on the exact years they moved to their current area of residence. The data contain unique GPS information of each household cluster, allowing us to accurately assess the intensity of refugees' influx by relying on the distance between households and each of the 13 historical refugee camps. In total, our analysis relies on a sample of 13,266 women ages 15-49 and 10,223 children ages 0-5 living in 608 clusters across the entire country. The sub-sample used for the analysis includes those households who never migrated (90.1%) or migrated before or during the refugee crisis (9.9%). For these households, we know with certainty whether they were living in refugee affected areas or not for at least part of the crisis. The sub-sample of households who migrated after 2001 is only used for our placebo tests. The reason is that there is no way to tell if those who migrated to their current place of residence after 2001 were previously in refugee affected areas or not prior to 2001 (the DHS does not provide information on multiple migration spells, only migration to the current place of residence).

In an effort to provide some explanations to the findings of the main analysis, we also use older DHS data to study the socio-economic characteristics of grandmothers of children in 2015/2016. We use the 1991/1992 DHS to empirically assess labor market outcomes of grandmothers prior to the refugee influx in 1993. We also use the 1996 DHS data to assess the short-term impacts of refugees' influx on under five years old children's health outcomes and grandmothers' labor market participation during the first phase of the influx from October 1993 to December 1996.

5. Empirical Strategy

Our empirical approach follows the main strategy used by the literature on measuring the impact of forced displacement on host communities where the interaction between the treatment group (T) and the refugee shock (R) is the variable of interest.[16] The general equation is described as follows:

$$Y_{ijkt} = \alpha + \gamma_t + m_j + \theta_k + \beta_1 T_i^q R_k + \beta_2 T_i^q + \beta_3 X_i + \varepsilon_{ijkt} \qquad (5.1)$$

where Y_{ijkt} is the Height for Age Z score or the probability of Stunting (HAZ <-2 SD) of the child i living with parents (mothers or fathers) in the cluster k and born in year t from the mother j, γ_t is the child's year of birth fixed effect, m_j is the mother's year of birth fixed effect, X_i are a set of children and household level characteristics including the gender and birth order of the child, the gender of the household head and the age of the mother j when giving birth to the child i, θ_k are cluster fixed effects and ε_{ijkt} is an idiosyncratic error term. The cluster fixed effects allow us to control for unobserved heterogeneity at the geographic level. However, we are mindful that this heterogeneity might be non-additive.

As in previous literature, R_k is our refugee shock variable instrumented using the inverse of household distance from refugee camps as follows:[17]

[16] See Verme and Schuettler (2019) for a review of these models.
[17] See Verme and Schuettler (2019) for a review of similar instruments.

$$R_k = \text{Log}\left(\sum_{c=1}^{13} \frac{Pop_c}{(Dist_{kc})^{\partial}}\right)$$

where c are refugee camps, Pop_c is the average population in 1993-1995 in each refugee camp and $Dist_{kc}$ is the distance in km of each cluster k to each refugee camp. This distance is alternatively modeled with $\partial = 0.5, 1, 2$ and 3 (squared, linear, quadratic and cubic functions). The coefficient of interest is therefore β_1 which measures the effect of the interaction between the treatment group and the intensity of the refugee presence adjusted for the inverse of the distance from the 13 refugee camps. Figure A3 shows the geolocation of our 608 clusters and 13 refugee camps based on which we compute R_k.

T_i^q is our treatment variable. We will consider five flavors of this variable (q=1, 2,3 4, and 5) depicted in Figure A2 and described as follows:

- $T_j^{q=1}$ is a binary variable equal to 1 if the mother j of child i was exclusively born or solely spent her early childhood during either the first (1993-1996) or the second period (1997-2001) of refugees' influx and 0 otherwise. This is the main cohort of treated mothers we consider ("main cohort" in Figure A2).

- $T_j^{q=2}$ is a continuous variable measuring the number of years spent under the presence of refugees for mothers who were born or exclusively spent their early childhood in the presence of refugees. This is also the main cohort we consider but measured in terms of duration of exposure to refugees rather than simple exposure as in *q*=1.

- $T_j^{q=3}$ is a categorical variable equal to 2 if the mother j of child i was exclusively born or solely spent her early childhood during the first (1993-1996) refugees' inflow period; equal to 1 if the mother j of the child i was exclusively born or solely spent her early childhood during the second refugee influx period (1997-2001) and 0 otherwise. This variable essentially compares the treated groups across the two refugee influx periods against mothers who were not exposed to refugee influxes ("control cohort" in Figure A2).

- $T_j^{q=4}$ is a binary variable equal to 1 if the mother j of child i spent some years of her early childhood out and others inside the first period of refugees' presence. This is the 1988-1993 cohort ("mixed cohort" in Figure A2), and 0 otherwise ("control cohort" in Figure A2).

- $T_j^{q=5}$ is a binary variable equal to 1 if the mother j of child i spent some years of her early childhood out and others inside the first and second period of refugees' presence (was born or less than five years old between 1988-1996 in Figure A2), and 0 otherwise ("control cohort" in Figure A2).

We also allow for heterogeneity of mother's age by the end of the first (1993-1996) refugee influx by constructing a categorical variable (d) that captures different stages of mothers' early childhood development with *d*=0 if the mother was born before 1988 (base category), *d*=1 if she was in utero *d*=2 if she was between 0 and 2 years old and *d*=3 if she was between 3 and 5 years old by the end of the first refugee influx period (December 1996). Recall that this corresponds to the period before most of the camps (mainly the Rwandese camps) started closing. Heterogeneity of mothers' age at the time of the crisis is modeled in a separate equation described as follows:

$$Y_{ijkt} = \alpha + \gamma_t + m_j + \theta_k + \beta_1 T_i^0 R_k d_j^s + \beta_2 T_i^0 d_j^s + \beta_3 X_i + \varepsilon_{ijkt} \qquad (5.2)$$

where T_i^0 refers to mothers who were in age 0-5 between 1993 and 1996, d_j^s refers to the mothers' cohort with *s*=1 if the mother was in utero, *s*=2 if she was 0 to 2 years old and *s*=3 if she was 3 to 5 years old. The analysis is restricted to mothers born after January 1, 1979 (less than 16 years old at the time of the first refugee inflow in 1993) and throughout our analysis our control group consists of mothers born between 1979 and 1988 (more than 5 years of age in 1993).

6. Results

6.1 Means Difference Tests

Before moving forward with the econometric analysis, we provide simple means t-tests on the main outcomes of interest between refugee and non-refugee affected areas before the refugee crisis using the 1991-1992 DHS. Table 1 provides the results splitting the sample into its 1991 and 1992 components to allow for some heterogeneity between the two years covered by the DHS. While it would be plausible to find differences given the different geographical areas considered, we do not find any statistical difference in our main outcomes of interest (HAZ and stunting). This provides a nice benchmark for the econometric analysis.

Similarly to the geographical comparison, in Table 2 we compare 0-5 and 6-16 y.o. cohorts of children using the 1991-1992 DHS (mothers in 2015/2016). As before, we could expect some differences but the t-tests show no difference in the main outcomes considered (HAZ and stunting). In Table 2, we also compare mothers' outcomes (grandmothers in 2015/2016) in terms of selected health, labor and education characteristics but do not find significant differences across children cohorts. Again, these are not expected results but provide a good setting for the econometric analysis.

6.2 Main Results

The main results are reported in Tables 3 and 4 where the rows represent the different flavors of treatment and control groups (q in Equation 5.1 and d in Equation 5.2) and the columns represent the different flavors of the shape of the relationship between dependent and independent variables (∂ in R of Equation 5.1). The tables exclusively report the coefficient of interest ($\beta_1$in equation 1) for Height for Age (HAZ) and the probability of stunting (prob(HAZ <-2 SD)). Equations under model 5.1 and 5.2 in Tables 3 and 4 include all controls discussed in the data section.

Height for Age Z (HAZ)

Results from Equations 1-5 under model 5.1 (Table 3) show that the impact of the refugee crisis on HAZ is almost univocally negative and significant. As compared to the control group, children of mothers who have been exposed to a refugee shock in their early age (first five years) have a lower height for their age. This result is robust to almost any specification of the treatment and control group with the exception of *q*=4. For example, in the case of $\partial = 1$, switching from treated to non-treated while controlling for the (log) distance, decreases the HAZ by 0.255 points (*q*=1). In other words, under five years old children born to mothers who were living 100 km (10 km) closer to the epicenter of the 13 refugee camps in their first five years of life have on average a HAZ score approximately 0.04 SD (0.004 SD) lower than their peers living 100 km (10 km) further away. Similarly, mothers who spent an additional year of their early childhood (0-5) under the presence of refugees (*q*=2) give birth in the next generation to children with an average HAZ of 0.0325 smaller than the control group (controlling for the log of the distance). Or, under five years old children born to mothers who spent an additional year of their early childhood under the presence of refugees and in a radius of 100km (10 km) closer to the epicenter of the 13 refugee camps have on average a HAZ score approximately 0.005 SD (0.0005 SD) lower than their peers.

For *q*=3, we observe that HAZ tends to be higher for mothers who were exposed to refugees during the second phase of the shock (1996-2001) as compared to those exposed during the first phase (1993-1996). However, the statistical significance tends to be more pronounced for those exposed in the first period (1%) as compared to those exposed in the second period (10%). The specifications *q*=4 and *q*=5 allow us to test if mothers who non-exclusively spent their first five years of life under the refugee presence (born between 1988 to 1993 and who were previously left out of our analysis) also tend to give birth to children who are more likely to be stunted. Results from *q*=4 suggest that the HAZ of children of mothers born between 1988 and 1993 are not statistically different from the HAZ of our control group. This latter result is not surprising given that *q*=4 compares mothers born between 1988 and 1993 who did not solely grow up in the presence of refugees with those who spent their early years of life in the absence of refugees. Results from *q*=5 encompassing mothers born to 1988 to 1996 in the treated group makes us infer that the statistical significance is obtained thanks to the group of mothers born during the "high" refugee influx period (born between 1993 and 1996). Therefore, results across the five *q* flavors of control groups are consistent in sign and significance and in pinpointing the peak of the refugee crisis (1993-1996) as the most crucial period to capture the intergenerational effect on children's health.

It is also visible that all coefficients decrease with the increase in ∂ (the power of the distance). For *q*=1 for example, the coefficients decrease from -0.512 for the square root case to -0.102 for the cubic case. This decrease persists across specifications and it is large shifting from the square root to the squared power while seems to slightly stabilize between the squared and cubic power. Given that the distance is expressed in log terms, this simply indicates that the relation between Height for Age and our key variable is rather linear in distance.

Results for the different *d* cohorts of mothers (Equation 6 under model 5.2, Table 3) are also consistent in sign and coefficients although consistent significant values are visible only for *d*=2. The HAZ score is negatively associated with the refugee shock. In line with the early childhood development literature, we find that the magnitude of the adverse effects of the refugee shock is more pronounced for mothers who were still in utero with the magnitude progressively decreasing for children of mothers who were 0-2 and 3-5 years old. However, only the 0-2 age cohort (*d*=2) shows a statistically significant effect across all the different functional forms of the distance. Hence, we could infer that children born to mothers who spent their first 24 months of life under the refugee presence during the 1993-1996 period gave birth to children with a lower HAZ score (-0.292 with ∂ =1). With ∂ =3, we also have a significant effect with *d*=3 (3-5 years old) which provides some substance to the argument of a decreasing effect across cohorts (-0.0766 with ∂ =3 as compared to -0.113 for *d*=2 and -0.168 for *d*=1).

Stunting $(\text{prob}(\text{HAZ} \leq -2\text{SD}))$

Results for stunting are shown in Table 4 using the same format as Table 3. Equations 1-5 under model 5.1 show that all coefficients are positive, and most are significant with the exceptions of *q*=3 in the Category 1 and *q*=4. In line with the results on the HAZ score, stunting increases for children born to mothers who experienced a refugee shock at early age. Coefficients for ∂ =1 vary between 0.0152 and

0.114 whereas coefficients across the different ∂ log specifications point again to an inverse linear relationship between children's stunting and distance from the refugee shock.

Results on stunting across mothers (*d*) cohorts (Equation 6 under model 5.2, Table 4) are supportive of previous results in that coefficients are positive and significant. However, as opposed to what we found for the HAZ, coefficients for stunting are significant (at a 10% level) for children whose mothers were in utero during the refugee shock but also for mothers who were 3-5 years old (at a 5% level). Similarly, the magnitude of the shock on stunting decreases from exposure in-utero to exposure in older age. For ∂ =1, mothers exposed in-utero show a coefficient of 0.186 compared to 0.119 for those who were 0-2 years old at the time of the shock and only 0.0838 for those exposed between 3 and 5 years old. As a more practical interpretation, we could infer that under five years old children born to mothers who were in-utero by the end of the first refugee influx period and were living 100km (10 km) closer to the epicenter of the 13 refugee camps are approximately 2.9 percentage points (0.29 percentage points) more likely to be stunted. Those results corroborate with findings of the early childhood development literature in that in utero and the first three years after birth are considered the most important and critical developmental period for later life adult outcomes and health anthropometrics of the next generation (Almond, 2006; Rosales-Rueda, 2018; Gluckman and Hanson, 2004). In conclusion, HAZ and Stunting depict a very consistent picture in that Height for Age is inversely related to the exposure of mothers to a refugee shock in early childhood. All signs and coefficients are consistent across all equations' specifications, with stunting emerging as a better indicator to capture early childhood cohorts' effects.

One could argue that our results might be picking up geospatial aspects of well-being in Tanzania with mothers of children living closer to the capital Dar es Salaam being more likely to have better health outcomes. It could also be that children born to older mothers and therefore much more experienced present better anthropometrics than children born to younger mothers. We perform four different placebo tests to rule out the eventuality of these and other factors playing a role in our results.

6.3 Robustness Checks

Our results are robust to four different placebo tests (Table 5). We first restricted the sample to those who migrated within Tanzania after 2001 and re-run equation 5.1 with *q*=1 and ∂ =1.[18] For this group,

[18] Recall that this is the group for which we cannot identify the place of residency at the time of the crisis and therefore the distance from camps.

we should not expect any impact or a much lower impact on HAZ or stunting and we indeed find that there is no impact (Test 1, Table 5).[19]

Second, we restricted the sample to those who migrated before 2001 (during the refugee shock) but living very far away from refugee camps (in clusters/regions that are located in the South-East of the country). For this group, we should expect a much lower impact than for those who migrated in regions closer to the camps and indeed we find no significant effect (Test 2, Table 5). We also follow Baez (2011) by restricting the sample to those who were residing in Northwestern Tanzania[20] distinguishing between geographical clusters of high refugee intensity and low refugee intensity and we find as expected significant results for high refugee intensity clusters ("North-West" in Table 5) in line with our results in Tables 3 and 4. Therefore, distance from the refugee shock is indeed a critical factor to understand the relation between child stunting and mothers' exposure to shocks.

Third, we checked whether results are not driven by a "*cohort effect*" by comparing anthropometrics of children from mothers born after 1993 to those born before 1993 without introducing the distance to a refugee camp (Test 3, Table 5). Also, in this case we found no statistically significant differences between the two groups in terms of their children's anthropometrics. This confirms that the cohort effect found in Tables 3 and 4 is determined by the distance from camps (the refugee crisis).

Fourth, we made use of the 1990/1991 pre-refugee arrival DHS survey to study whether parents/children living further away from refugee camps were already better or worse off prior to refugees' arrival in late 1993. Again, we find no statistically significant differences between health anthropometrics of under five years old children from communities of refugees hosting areas and non-refugees hosting areas (Test 4, Table 5).

Finally, the extent to which other events in Tanzania such as natural disasters (namely the 1998 *el nino* flooding and the 1999 drought) might have undermined socio-economic conditions of mothers during refugee influx and subsequently their children's health outcomes in 2015/2016 is dismissed. The *el nino* flooding of 1998 followed by the severe drought in 1999 mainly hit the central and northeastern part of the country (Arusha, Manyara, Shinyanga, Simiyu, and Dodoma regions), all areas that did not experience the massive inflow of refugees in the country.

[19] Recall that for households declaring to have moved to the current location after 2001 we cannot identify their location during the refugee crisis. We can consider this group as a random sample in terms of distance from refugee areas.
[20] Biharamulo, Muleba, Bukoka Rural and Bukoka Urban.

6.4 Transmission Mechanisms

While the association between the refugee shock and nutrition outcomes for children of mothers who lived under the shock in early age has proven to be robust, the mechanisms that turned the shock into these results remain unexplored. These mechanisms can be many, are difficult to capture with retrospective data and would require a separate study. However, our data contains information on grandmothers of the children we found in 2015-2016 and this allows us to explore the hypothesis that these are children of mothers who, because of the refugee shock, may have received reduced home care during early childhood. Studies on early childhood development have largely documented the importance of the first five years of life for health and nutrition, cognitive behavior, earnings, motherhood and other outcomes in adulthood and it is possible that the refugee shock has altered the behavior of grandmothers in a way that affected mothers later in life.

What we know from previous studies on refugees in Tanzania is that household well-being increased for households living close to the refugee camps. Most importantly, the sudden arrival of refugees created temporary secondary employment opportunities for mothers and fathers who, as a consequence, should have been expected to dedicate less time to intrahousehold domestic chores including child care. Our hypothesis is that an increase in female labor market participation and the decrease in health and educational services already documented has led to a decrease in child care. In Table 6, we first use the treatment group q=1 to see whether grandmothers[21] who lived under the refugee crisis in 1996 (during the crisis) had a higher labor market participation than those in 1991(before the crisis). We find that grandmothers who lived under the refugee shock in 1996 had a higher labor market participation than grandmothers in 1991 whereas we find no statistically significant increase of children's grandfathers' labor market participation as a result of the refugee arrival. This confirms previous findings that showed an increase in female labor force participation during the refugee crisis.

We also investigate the long-term impacts of refugees' arrival on contemporary socio-economic outcomes of mothers and fathers. We explore the potential mechanisms by focusing on parental endowments in terms of assets, level of education and labor market participation. We estimate the following econometric model for mothers and fathers:

$$PE_{jkt} = \beta_0 + P_j + \theta_k + \beta_1 T_j^1 R_k + \beta_2 T_j^1 + \varepsilon_{jkt} \qquad (6.1)$$

[21]Note that these are mothers in 1991 and 1996. We call them grandmothers, as our analysis focuses on 2015-2016 children outcomes.

where PE_{jkt} is the level of human capital endowment of the mother or father j living in the cluster k and born in year t; P_j is the parent's year of birth fixed effect; θ_k are cluster fixed effects and ε_{jkt} is an idiosyncratic error term. Again, the analysis is restricted to mothers or fathers born after January 1, 1979 (less than 16 years old at the time of the first refugee inflow in 1993). Throughout our analysis, our control group consists of mothers born between 1979 and 1988. As before, the coefficient of interest is β_1 and T_j^1 is a binary variable equal to 1 if the parent j of child i was exclusively born or solely spent her/his early childhood during either the first (1993-1996) or the second period (1997-2001) of refugees' influx and 0 otherwise. This is the main cohort of treated parents we consider ("main cohort" in Figure A2).

Results are reported in Table 7. We find that mothers who spent their first five years of life under the presence of refugees are less likely to complete more than secondary education as adults. This reinforces the findings of previous studies on the long-term impact of early life exposure to shocks and schooling performance (Shah and Steinberg, 2013 and Cunha et al., 2006). They are also less likely to own land and a house and more likely to participate to the labor market later in their life. In particular, increased labor market participation can potentially translate into reduced child care at home and poorer anthropometrics of their less than 5 years old offspring, as shown in previous literature (see e.g. Saabneh, 2016; Hill et al. 2005; Brooks-Gunn et al., 2002; Belsky and Eggebeen, 1991). In the same vein, we find that fathers who spent their first five years of life under the presence of refugees are less likely to own key assets such as land and house. However, early life exposure to refugees has no long-term impacts on fathers' labor market participation and their attainment of more than secondary education.

Finally, we use the 1991/1992 and 1996 DHS data to assess whether under five years old children's anthropometric health outcomes in 1996 (during the crisis) were worse off as compared to 1991/1992 (prior to the crisis). We find in table 8 that children in refugee receiving areas in 1996 had lower Weight for Age, Weight for Height and a lower Biomass Index scores as compared to their peers. They were also more likely to be wasting, underweight, have diarrhea or fever. There is no evidence instead of an increased level of under five years old mortality in refugee receiving areas in 1996. In sum, these findings suggest that parents in their early age during the refugee influx suffered from decreased nutritional standards and increased morbidity. This, in turn, is expected to affect the anthropometrics of their own children in 2015-2016.

We shall derive that the increase in household well-being found by other studies is probably associated with higher female participation in the labor market, particularly for lower educated women who picked up low paid jobs in the informal service industry. This may imply that the children of these mothers had less exposure to their mothers' care during a period when education and health services were deteriorating. This provides a lead for future research into the mechanisms that may explain why children of mothers who lived under a refugee crisis at an early age have worse nutritional outcomes as compared to other children. It should also be recognized that, as for other similar studies, our results can still be contaminated by some form of unobserved heterogeneity. For example, while we control for local and geographical proximity, macroeconomic effects may not operate homogeneously within clusters and may affect children cohorts differently.

7. Conclusions

The main purpose of this paper was to empirically assess how mothers' exposure to refugees during their early childhood (0-5 years old) translates into lower health outcomes of their offspring born some 15-20 years after the shock. We used the latest 2015/2016 Tanzania Demographic and Health Survey to study the intergenerational health impacts of mothers on the Height for Age Z score and the probability of stunting of their children born 15 years after the massive arrival of refugees. By exploiting spatial and temporal variation in mothers' exposure to the refugee shock, we find that almost two decades later, children of mothers who were less than 5 years old at the time of the influx and living closer to the 13 main historical refugee camps are more likely to be stunted.

As key mechanisms, our paper hypothesized that the positive economic growth generated by the refugee influx resulted in increased female labor market participation during the refugee crisis that, combined with deteriorating education and health services, has had adverse effects on child care, nutrition and morbidity. The poor nutritional status of children at the time of the crisis might potentially translate into lower anthropometrics of their own children some 15 years later. In an attempt to identify key mechanisms, we found an increased participation in the labor market of mothers who spent their first five years of life in the presence of refugees. This might explain lower anthropometrics of their own under five years old children in line with the microeconomic literature on the negative effects of maternal employment on young children's development (see e.g. Baum II, 2003; Gregg et al., 2005). We also found that those mothers who were between 0 and 5 years old at the time of the refugee shock are more likely to achieve fewer years of education today and are also less likely to own key assets such as land and house. In short, their underachievement and lower assets ownership have had a negative impact on their children's health, as predicted by the early childhood development theory.

If these findings are confirmed, they call for aid organizations to consider the impact of a refugee crisis on mothers and small children in the host community and possibly provide support to education and health facilities and childcare where needed. Future research should attempt to identify how a refugee shock that translates into a labor market shock affects childcare and the intrahousehold division of labor.

References

Akresh, Richard, and Bhalotra, Sonia, Leone, Marinella.2018. “First and Second Generation Impacts of the Biafran War”.2018. *Households in Conflict Network Working Paper 254*

Almond, Douglas. 2006. "Is the 1918 Influenza pandemic over? Long-term effects of in utero Influenza exposure in the post-1940 US population." *Journal of Political Economy* 114(4): 672-712.

Almond, Douglas, and Janet Currie. 2011. “Human Capital Development before Age Five”. In *Handbook of Labor Economics* 4:1315-1486

Almond, Douglas, Kenneth Y. Chay, and David S. Lee. 2005. “The costs of low birth weight.” *Quarterly Journal of Economics* 120 (3): 1031-1083.

Almond, Douglas, Lena Edlund, Hongbi Li, and Junsen Zhang. 2010. “Long-term effects of early-life development: Evidence from the 1959 to 1961 china famine.” In *The economic consequences of demographic change in East Asia*, *NBER-EASE* 19: 321–345.

Almond, Douglas, and Bhashkar Mazumder. 2011. “Health capital and the prenatal environment: The effect of ramadan observance during pregnancy.” *American Economic Journal: Applied Economics* 3 (4*):* 56-85.

Alderman, Harold, John Hoddinott, and Bill Kinsey. 2006. “Long term consequences of early childhood malnutrition.” *Oxford Economic Papers* 58 (3): 450-474.

Alix-Garcia, Jennifer, and David Saah. 2010. “The Effect of Refugee Inflows on Host Communities: Evidence from Tanzania.” *World Bank Economic Review* 24 (1): 148–70.

Alvi, Eskander and Seife Dendir.2011. “Sibling differences in school attendance and child labour in Ethiopia”. *Oxford Development Studies* 39: 285-313

Baez, Javier E. 2011. "Civil Wars beyond their Borders: The Human Capital and Health Consequences of Hosting Refugees." *Journal of Development Economics* 96 (2): 391-408.

Baum II, Charles L. 2003. “Does Early Maternal Employment Harm Child Development? An Analysis of the Potential Benefits of Leave Taking”. *Journal of Labor Economics* 21(2) 409-448

Belsky, Jay and Eggebeen D. 1991. “Early and Extensive Maternal Employment and Young Children’s Socio-emotional Development: Children of the National Longitudinal Survey of Youth.” *Journal of Marriage and the Family* 53:1083-98.

Bhalotra, Sonia, and Samantha B. Rawlings. 2011. "Intergenerational Persistence in Health in Developing Countries: The Penalty of Gender Inequality?" *Journal of Public Economics* 95 (3–4): 286–99.

Brooks-Gunn, Jeanne, Wen-Jui Han, and Jane Waldfogel. 2002. "The Effects of Early Maternal Employment on Child Cognitive Development." *Demography* 39(2):369–392.

Bharadwaj, Prashant, and Rinchan Ali Mirza. 2019. "Displacement and development: Long term impacts of population transfer in India." *Explorations in Economic History* 73: 14-4983

Caruso, Germán Daniel. 2017. "The legacy of natural disasters: The intergenerational impact of 100 years of disasters in Latin America." *Journal of Development Economics* 127: 209-233.

Caruso, Germán Daniel, and Sebastian Miller. 2015. "Long run effects and intergenerational transmission of natural disasters: a case study on the 1970 Ancash Earthquake." *Journal of Development Economics* 117:134-150.

Caruso, Germán Daniel. 2015. "Intergenerational Transmission of Shocks in Early Life: Evidence from the Tanzania Great Flood of 1993." Unpublished http://www.Germáncaruso.com/IntergenerationalPaper11_11_14.pdf

Case, Anne, and Christina Paxson. 2008. "Stature and Status: Height, Ability, and Labor Market Outcomes." Journal of Political Economy 116 (3): 499–532.

Case, Anne, and Christina Paxson. 2010. "Causes and Consequences of Early-Life Health." Demography 47: S65–85.

Ceritoglu, Evren, Burcu Gurcihan Yüncüle, Huzeyfe Torun, and Semih Tumen. 2017. "The Impact of Syrian refugees on natives' labor market outcomes in Turkey: Evidence from a quasi-experimental design." *IZA Journal of Labor Policy* 6(5): 1-28.

Cook, C. Justin, Jason M. Fletcher, and Angela Forgues. 2018. "Multigenerational Effects of Early Life Health Shocks." *NBER Working Papers 25377*.

Currie, Janet. 2009. "Healthy, Wealthy, and Wise: Socioeconomic Status, Poor Health in Childhood, and Human Capital Development." *Journal of Economic Literature*, 47 (1): 87-122.

Cunha, Flavio, James J. Heckman, and Lance Lochner. 2006. "Interpreting the evidence on life cycle skill formation." In *Handbook of the Economics of Education* 1 (12): 697-812.

Cunha, Flavio, and James J. Heckman. 2007. "The technology of skill formation." *American Economic Review* 97 (2): 31-47.

Cunha, Flavio, James J. Heckman, and Suzanne M. Schennach.2010. "Estimating the technology of cognitive and noncognitive skill formation." *Econometrica* 78 (3): 883-931.

Del Carpio, Ximena V., and Mathis Wagner. 2015. "The Impact of Syrian Refugees on the Turkish Labor Market." *Policy Research Working Paper WPS No. 7402*.

Gluckman, Peter D., and Hanson M. 2004. “Living with the past: Evolution, development, and patterns of disease.” *Science* 305 (5691): 1733-1736.

Gregg, Paul, Elizabeth Washbrook, Carol Propper and Simon Burges (2005), “The Effects of a Mother's Return to Work Decision on Child Development in the United Kingdom”, *The Economic Journal* 115(501):48-80.

Hill, Jennifer, Jane Waldfogel, Jeanne Brooks-Gunn and Wen-Jui Han. 2005. “Maternal Employment and Child Development: A Fresh Look Using Newer Methods.” *Developmental Psychology* 41(6): 833-850.

Kibreab. Gaim, 1985. African Refugees: Reflections on the African Refugee Problem. Trenton: Africa World Press.

Landau, Loren B. 2003. “Beyond the losers: transforming governmental practice in refugee-affected Tanzania.” *Journal of Refugee Studies* 16(1): 19-43

Landau, Loren B. 2004. “Challenge without Transformation: Refugees, Aid and Trade in Western Tanzania.” *The Journal of Modern African Studies* 42(1): 31-59

Leroy Jef .L. and Edward A. Frongillo. 2019. “Perspective: What Does Stunting Really Mean? A Critical Review of the Evidence.” Advances in Nutrition 10(2): 196–204.

Mabiso, Arthur, Jean-François Maystadt, Joachim Vandercasteelen, and Kalle Hirvonen. 2014. “Refugees and food security in host communities: a review of impacts and policy options to enhance resilience.” Unpublished, wired at: http://www.ifpri.org/publication/refugees-food-security-and-resilience-host-communities-transitioning-humanitarian

Maccini, Sharon, and Dean Yang. 2009. “Under the weather: Health, schooling, and economic consequences of early-life rainfall.” *American Economic Review* 99 (3): 1006-1026.

Maluccio, John, John Hoddinott, Jere Behrman, Reynaldo Martorell, Agnes Quisumbing, and Aryeh D. Stein. 2009. “The impact of improving nutrition during early childhood on education among Guatemalan adults.” *Economic Journal* 119 (537): 734-763.

Maystadt, Jean-François, and Phillipe Verwimp. 2014. “Winners and losers among a refugee-hosting population.” *Economic Development and Cultural Change* 62: 769–809.

Maystadt, Jean-François, and Gilles Duranton. 2018. “The development push of refugees: evidence from Tanzania.” *Journal of Economic Geograph*y 19(2):1-36.

Montalvo, Jose G., and Marta Reynal-Querol. 2007. “Fighting against malaria: prevent wars while waiting for the “miraculous” vaccine.” *Review of economics and statistics* 89(1): 165–177.

Mwakasege, Christopher.1995. “Study Report: Impact of Refugees on Host Communities, the case of Kasulu, Ngara & Karagwe Clusters in Tanzania.” *Print of the Refugees Study Center of the University of Oxford (RSC).*

Osmani, Siddiq, and Amartya Sen. 2003. “The hidden penalties of gender inequality: fetal origins of ill-health.” *Economics and Human Biology* 1(1):105-121.

Peri, Giovanni, and Vasil Yasenov. 2019. "The Labor Market Effects of a Refugee Wave.” Journal of Human Resources 54(2): 267-309.

Puerto Gomez M., and Christensen Asger. 2010. “The Impacts of Refugees on Neighboring Countries: a development Challenge.” *World Development Report 2011 Background paper.*

Rosales-Rueda, Maria F. 2018. “Impact of early life shocks on human capital formation: El nino floods in Ecuador.” J*ournal of Health Economics* 62:13-44.

Rozo, Sandra, and Micaela Sviastchiy. 2018. “Are Refugees a Burden? Impacts of Refugee Inflows on Host’s Consumption Expenditures.” Unpublished https://www.sandravrozo.com/uploads/2/9/3/0/29306259/rsw_july2018.pdf

Ruiz, Isabelle, and Carlos Vargas-Silva. 2013. “The economics of forced migration.” *The Journal of Development Studies* 49: 772–784.

Ruiz, Isabelle, and Carlos Vargas-Silva. 2015. “The labor market impacts of forced migration.” *American Economic Review: Papers and Proceedings* 105(5): 581–586*.*

Ruiz, Isabelle, and Carlos Vargas-Silva. 2016. “The labor market consequences of hosting refugees.” *Journal of Economic Geography* 16 (3): 667–694.

Saabneh,Ameed. 2016. “The association between maternal employment and child survival in India, 1998–99 and 2005–06.” *Journal Asian Population Studies* 13(1): 67-85

Shah, Manisha, and Bryce Millett Steinberg. 2013. “Drought of opportunities: Contemporaneous and long-term impacts of rainfall shocks on human capital.” *NBER Working Paper No. 19140.*

Tafere, Kibrom. 2016. “Inter-generational Effects of Early Childhood Shocks on Human Capital: Evidence from Ethiopia.” Unpublished https://ageconsearch.umn.edu/record/236056/

Verme, Paolo and Kirsten Schuettler. 2019. “The Impact of Forced Displacement on Host Communities: A Review of the Empirical Evidence in Economics.” *Households in Conflict Network Working Papers,* No. 302

Waters, Tony. 1999. “Assessing the Impact of the Rwanda Refugee Crisis on Development Planning in Rural Tanzania, 1994–96.” *Human Organization* 58 (2):142–52.

Whitaker, Elise B. 1999. “Changing opportunities: refugees and host communities in Western

Tanzania.” *Journal of Humanitarian Assistance* 4 (1):1–23.

Whitaker, Elise B. 2002. “Refugees in Western Tanzania: The distribution of burdens and benefits among Local Hosts.” *Journal of Refugee Studies* 15 (4):339-358

Zhibo Tan, Xiaobo Zhang and Chih Ming Tan.2015. "Sins of the Fathers: The Intergenerational Legacy of the 1959-1961 Great Chinese Famine on Children's Cognitive Development.” *Working Paper series 15-33, Rimini Centre for Economic Analysis*.

Table 1: Children's anthropometrics prior to the influx of refugees (refugees Vs. non-refugees receiving areas)

	(1) Refugees Areas*	**(2) Non-refugees Areas**	**Overall**	**(1) vs. (2)**
1991				
Height-for-age Z-score	-1.986	-2.028	-1.991	0.042
	(0.028)	(0.069)	(0.026)	(0.082)
Stunting Prob (HAZ<-2SD)	0.513	0.542	0.516	-0.029
	(0.009)	(0.024)	(0.008)	(0.026)
1992				
Height-for-age Z-score	-1.890	-2.017	-1.902	0.127
	(0.031)	(0.088)	(0.030)	(0.102)
Stunting Prob (HAZ<-2SD)	0.489	0.529	0.492	-0.041
	(0.010)	(0.031)	(0.009)	(0.033)

Source: 1991/1992 Tanzania DHS.(*) Kagera, Kigoma, Geita, Mara, Mwanza and Shinyanga. Standard errors in parentheses.

Table 2 - Difference in mean of children's and mothers' outcomes before the refugees' arrival in 1991/1992 (0-5 Vs. 6-16 years old cohorts)

	(1) Children 6-16 at the time of the crisis in refugee affected areas*	(2) Children 0-5 at the time of the crisis in refugee affected areas*	Overall	Diff (1)-(2)	P-Value
	Children characteristics				
Height-for-age Z-score	-2.171	-1.995	-2.024	-0.176	0.163
	(0.110)	(0.061)	(0.054)	(0.126)	
Stunting Prob (HAZ<-2SD)	0.563	0.532	0.537	0.030	0.554
	(0.047)	(0.021)	(0.019)	(0.051)	
	Mother characteristics				
Mother's weight (kilos-1decimal)	534.871	526.723	528.246	8.148	0.272
	(6.775)	(3.020)	(2.764)	(7.406)	
Delivery at hospital	0.450	0.405	0.413	0.045	0.311
	(0.041)	(0.019)	(0.017)	(0.045)	
Age of respondent at 1st birth	18.290	18.510	18.469	-0.219	0.409
	(0.239)	(0.115)	(0.104)	(0.265)	
Respondent Currently working	0.748	0.714	0.721	0.034	0.382
	(0.035)	(0.017)	(0.016)	(0.039)	
More than primary education	0.555	0.620	0.608	-0.065	0.140
	(0.040)	(0.019)	(0.017)	(0.044)	
More than secondary education	0.032	0.015	0.018	0.018	0.241
	(0.014)	(0.005)	(0.005)	(0.015)	
N	155	679	834	834	

Source: 1991/1992 Tanzania DHS. .(*) Kagera, Kigoma, Geita, Mara, Mwanza and Shinyanga. Standard errors in parentheses.

Table 3 - Height for age Z score (HAZ) Equations

Eq.#	Independent Variable Specification	∂ =0.5	∂ =1	∂ =2	∂ =3
	Model 5.1				
1	q=1	-0.512***	-0.255***	-0.126***	-0.102***
		(0.180)	(0.0891)	(0.0439)	(0.0337)
2	q=2	-0.0653**	-0.0325**	-0.0161**	-0.0129***
		(0.0268)	(0.0132)	(0.00651)	(0.00498)
4	q=4	-0.125	-0.0612	-0.0293	-0.0229
		(0.196)	(0.0969)	(0.0476)	(0.0361)
5	q=5	-0.297*	-0.147*	-0.0721*	-0.0571**
		(0.153)	(0.0758)	(0.0375)	(0.0288)
	N	3202	3202	3202	3202
6	q=3, Cat 2 (1993-1996)	-0.508***	-0.253***	-0.126***	-0.102***
		(0.193)	(0.0956)	(0.0470)	(0.0359)
	q=3, Cat 1 (1996-2001)	-0.746*	-0.373*	-0.186*	-0.155*
		(0.420)	(0.209)	(0.103)	(0.0819)
	N	2961	2961	2961	2961
	Model 5.2				
6	d_1, in utero	-0.820	-0.409	-0.204	-0.168
		(0.588)	(0.292)	(0.145)	(0.114)
	d_2, 0-2 years old	-0.586**	-0.292**	-0.145**	-0.113**
		(0.282)	(0.140)	(0.0697)	(0.0552)
	d_3, 3-5 years old	-0.360	-0.180	-0.0899	-0.0766*
		(0.229)	(0.113)	(0.0555)	(0.0418)
	N	3103	3103	3103	3103

Source: 2015/2016 Tanzania DHS. Standard errors in parentheses, Standard Errors clustered at the cluster level. In addition to cluster fixed effects, the regression controls for the gender of the head, the birth order and gender of the child but also mother and child year of birth fixed effects; * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 4 - Stunting (Prob (HAZ<-2SD)) Equations

Eq.#	Independent Variable Specification	∂ =0.5	∂ =1	∂ =2	∂ =3
	Model 5.1				
1	q=1	0.208***	0.103***	0.0511***	0.0401***
		(0.0613)	(0.0304)	(0.0150)	(0.0116)
2	q=2	0.0307***	0.0152***	0.00750***	0.00583***
		(0.00907)	(0.00449)	(0.00221)	(0.00170)
3	q=3, Cat 2 (1993-1996)	0.230***	0.114***	0.0565***	0.0444***
		(0.0651)	(0.0323)	(0.0160)	(0.0124)
	q=3, Cat 1 (1996-2001)	0.205	0.102	0.0510	0.0412
		(0.165)	(0.0823)	(0.0408)	(0.0329)
4	q=4	0.0579	0.0283	0.0136	0.00962
		(0.0691)	(0.0343)	(0.0170)	(0.0133)
5	q=5	0.134***	0.0664***	0.0325***	0.0246**
	N	*3202*	*3202*	*3202*	*3202*
		(0.0496)	(0.0246)	(0.0122)	(0.00966)
	Model 5.2				
6	d_1, in utero	0.373*	0.186*	0.0923*	0.0737*
		(0.211)	(0.105)	(0.0520)	(0.0414)
	d_2, 0-2 years old	0.240***	0.119***	0.0591***	0.0460**
		(0.0908)	(0.0452)	(0.0224)	(0.0179)
	d_3, 3-5 years old	0.169**	0.0838**	0.0415**	0.0332**
		(0.0738)	(0.0365)	(0.0179)	(0.0135)
	N	*3103*	*3103*	*3103*	*3103*

Source: 2015/2016 Tanzania DHS. Standard errors in parentheses, Standard Errors clustered at the cluster level. In addition to cluster fixed effects, the regression controls for the gender of the head, the birth order and gender of the child but also mother and child year of birth fixed effects; * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 5 – Placebo Tests

	HAZ score	Stunting
Test 1: Mothers not present in refugee areas		
q=1, ∂ =1	-0.406	0.0862
	(0.249)	(0.117)
N	*2315*	*2315*
Test 2: South-East Vs. North-West Regions		
q=1, ∂ =1, South-East	0.0221	-0.135
	(0.945)	(0.299)
q=2, ∂ =1, South-East	0.00214	-0.00235
	(0.132)	(0.0512)
N	*429*	*429*
q=1, ∂ =1, North-West[22]	-0.765***	0.173*
	(0.259)	(0.0917)
q=2, ∂ =1, North-West	-0.0875**	0.0229*
	(0.0342)	(0.0120)
N	*782*	*782*
q=1, ∂ =1, North-West, Low Treatment areas (East)[23]	1.031	-0.0242
N	(2.859) *75*	(0.828) *75*
Test 3: Young Vs Old Mothers (Born before 1993)	1.204	-0.143
	(0.762)	(0.187)
Test 4: Refugee hosting Vs. non-hosting areas (children before the crisis)	-0.0615	0.0311
	(0.0777)	(0.0241)

Source: 2015/2016 and the 1991/1992 Tanzania DHS. Standard errors in parentheses, Standard Errors clustered at the cluster level. In addition to cluster fixed effects, the regression controls for the gender of the head, the birth order and gender of the child but also mother and child year of birth fixed effects; * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

[22] These are Kagera, Kigoma, Geita, Mara, Mwanza and Shinyanga.

[23] These are are Biharamulo, Muleba, Bukoka Rural and Bukoka Urban districts, which have been defined as high treatment districts by Baez (2011) using retrospective information from the 5th round of 2004 Kagera Health and Development Survey (KHDS).

Table 6– Labor Force Participation of Grandmothers and Grandfathers by 1996

	Children's Grand Mothers' Labor Force Participation	**Children's Grand Fathers Labor Force Participation**
Refugeearea#in1996sample (Kagera and Kigoma)	0.0562**	0.0346
	(0.0238)	(0.0234)
N	*3317*	*724*
Adj. R^2	0.035	0.004

Source: 1991/1992 and 1996 Tanzania DHS. Standard errors in parentheses, Standard Errors clustered at the cluster level. In addition to cluster fixed effects, the regression controls for the gender of the head, the birth order and gender of the child but also mother and child year of birth fixed effects; * p < 0.10, ** p < 0.05, *** p < 0.01.

Table 7 – Labor Force Participation, Education and Assets of Mothers and Fathers in 2015/2016 (Model 6.1)

	Labor Market Participation	**More than Secondary**	**Own land**	**Own house**
Q=1, Mothers	0.127***	-0.0365*	-0.0644***	-0.0827***
	(0.0421)	(0.0196)	(0.0212)	(0.0229)
N	4910	4912	4912	4912
Q=1, Fathers	0.0698	0.00343	-0.0985***	-0.0869***
	(0.0524)	(0.0351)	(0.0343)	(0.0321)
N	*2191*	*2197*	*2197*	*2197*

Source: 2015/2016 Tanzania DHS. Standard errors in parentheses. Standard errors are clustered at the cluster level. In addition to cluster fixed effects, the regression controls for the gender of the head, the birth order and gender of the child but also mother and child year of birth fixed effects; * p < 0.10, ** p < 0.05, *** p < 0.01.

Table 8. Under five years old children's anthropometric in refugee areas in 1996 (after) as compared to 1991 (before the influx)

	Height for Age (HAZ)	Weight for Age	Weight for Height	Body Mass Index
c.refugee#c.after	0.0315	-0.176**	-0.259***	-0.207***
	(0.0861)	(0.0685)	(0.0647)	(0.0609)
N	11232	11515	11176	11188
adj. R^2	0.042	0.015	0.017	0.026

	Stunting	Wasting	Underweight
c.refugee#c.after	-0.0118	0.0443**	0.0552***
	(0.0193)	(0.0163)	(0.0197)
N	11232	11176	11515
adj. R^2	0.035	0.008	0.006

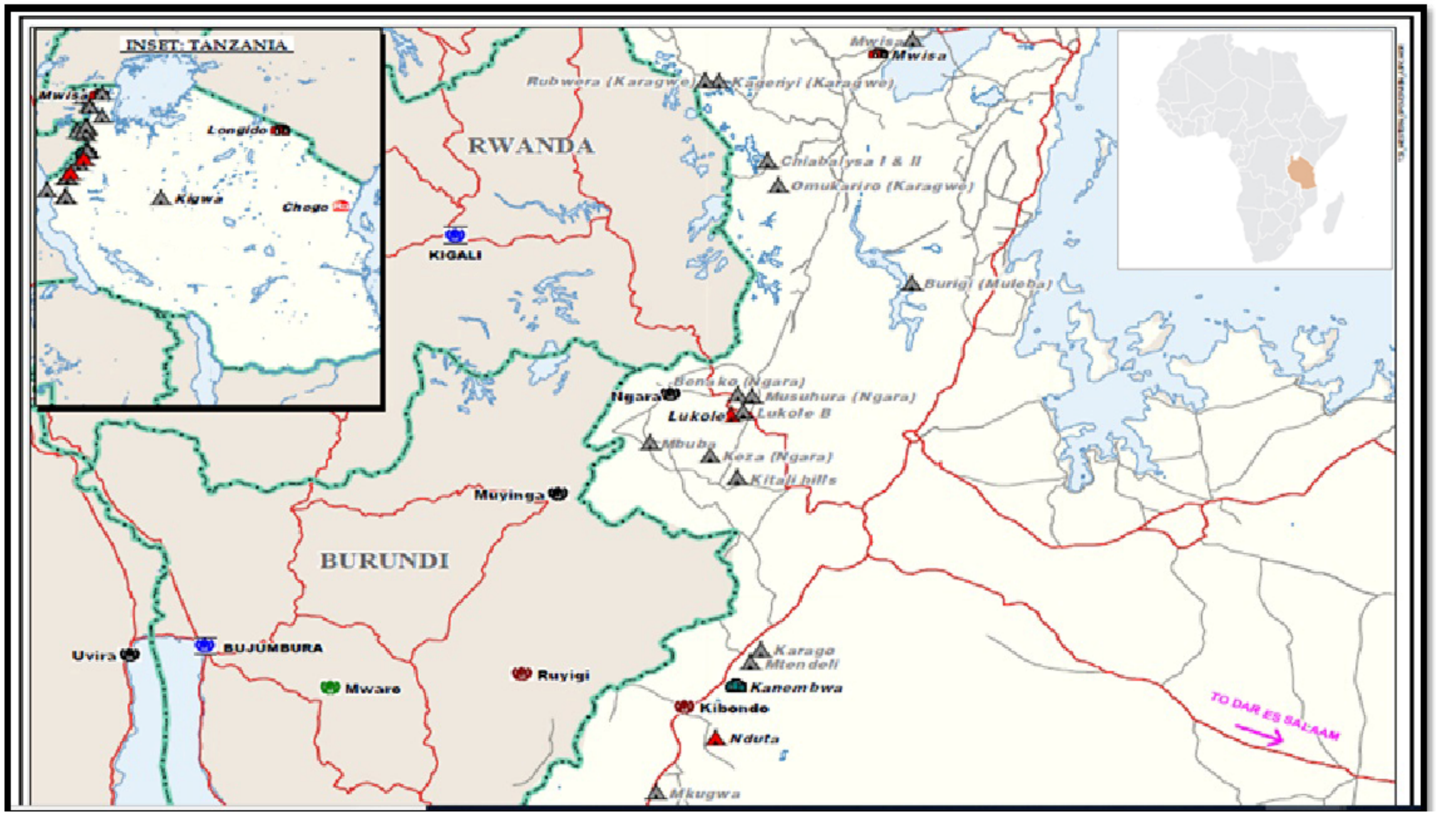
	Under five mortality	Mortality (1 month)	Mortality (12 months)	Mortality (24 months)
c.refugee#c.after	-0.0133	-0.000409	-0.0202**	-0.0162
	(0.0153)	(0.00757)	(0.00818)	(0.0145)
N	13879	13879	13879	13879
adj. R^2	0.006	-0.000	0.002	0.005

	Had diarrhea recently	Had fever in the last two weeks
c.refugee#c.after	0.272***	0.0965*
	(0.0323)	(0.0506)
N	11957	11912
adj. R^2	0.036	0.019

Source: 2015/2016 Tanzania DHS. Standard errors in parentheses. Standard errors are clustered at the region level., the regression controls for the gender of the head, the birth order and gender of the child but also child year of birth fixed effects. * p < 0.10, ** p < 0.05, *** p < 0.01. *After= in 1996 after refugees' arrival.

ANNEX A:

Figure A1 - Location of Refugee Camps in Northwestern Tanzania



Source: UNHCR RSAL[24] and Fieldwork from Maystast and Duranton (2018).

[24] Regional Spatial Analysis Lab.

Figure A2 - Definition of Treatment and Control Groups and Age Cohorts

Refugee influx Period I:
October 1993-December 1996

Refugee influx Period II:
January 1997 -July 2001 Period

Mother/ Father Year of Birth	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Age of the mother in January 1994	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	-1	-2	-3	-4	-5	-6	-7
⇩ Mother Age Category by the end of the refugee influx period I (December 1996) ⇩																								
In utero																								
0 to 2 y.o.																								
3 to 5 y.o.																								
Exposure																								

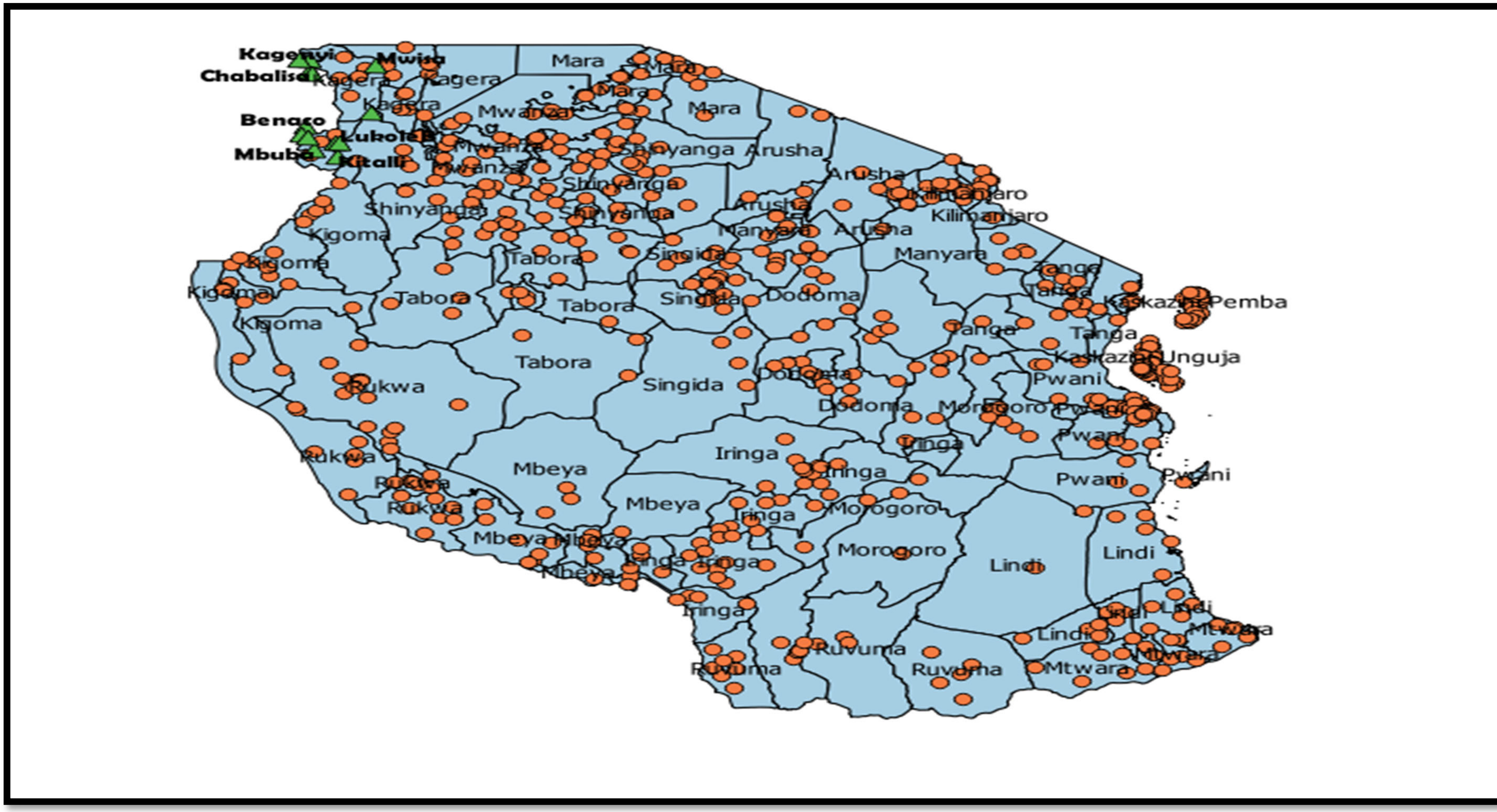
CONTROL COHORT
Not in early childhood during the refugees' influx period I and II

Parents (Mothers and Fathers) who were NOT in their early childhood (more than 5 years old) and born after 1978(3)

MIXED COHORT
Some early childhood (0-5) during and before the refugees' influx period I and II
Parents who spent some years of their early childhood during or before the refugees' influx (1988 to October 1993)

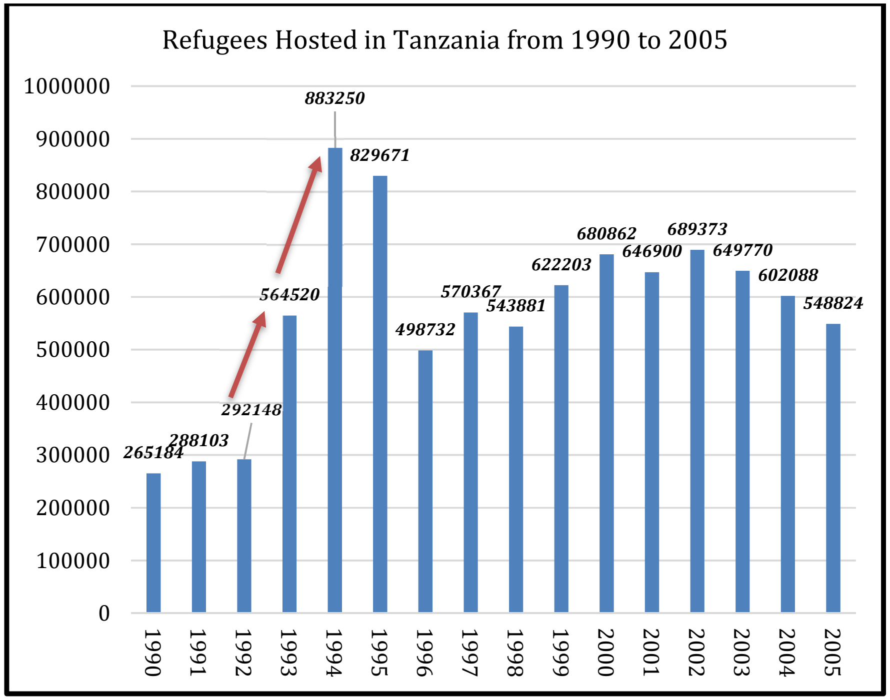
MAIN TREATMENT COHORT
Early childhood (0-5) during the refugees' influx period I and II
Parents (Mothers and Fathers) who were in their early childhood between October 1993 and July 2001 (date of birth of the youngest mother in the sample)

Figure A3: Location of Refugee Camps and DHS clusters in Northwestern Tanzania



Source: DHS and UNHCR RSAL data, by QGIS.

Figure A4: Number of Refugees hosted in Tanzania from 1990 to 2005



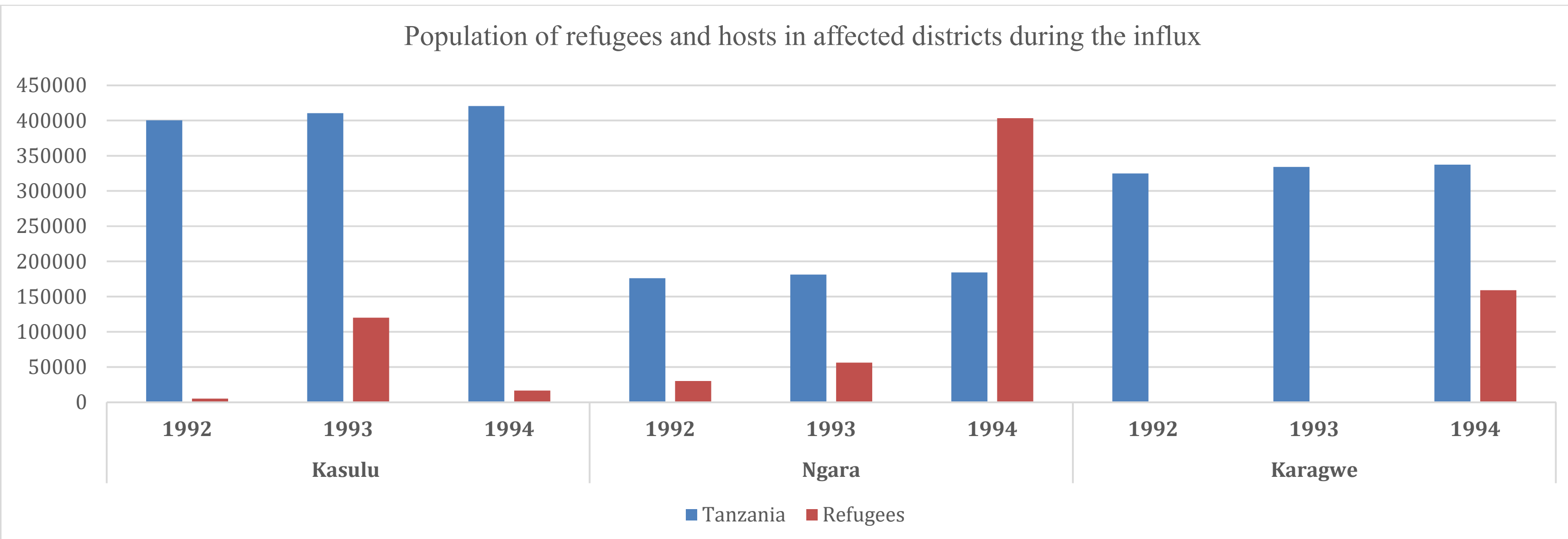
Source: UNHCR Population Statistics.

Table A1: Distribution of refugees and hosts in the most affected clusters of Kasulu, Ngara and Karagwe between 1992 and 1994

	Kasulu			***Ngara***			***Karagwe***		
	1992	1993	1994	1992	1993	1994	1992	1993	1994
Tanzanians	400,320	410,400	420,480	176,153	181,227	184,230	324,853	334,210	337,316
Refugees	5,140	120,043	16,460	30,000	56,310	403,304	NA	NA	159,160
Proportion	***1.28%***	***29.25%***	***3.91%***	***17.03%***	***31.07%***	***218.91%***	***NA***	***NA***	***47.18%***
Total	405,460	530,443	436,940	206,153	237,537	587,534	324,853	334,210	496,476

Source: UNHCR Population Statistics.

Figure A5: Distribution of refugees and hosts in the most affected clusters of Kasulu, Ngara and Karagwe between 1992-1994



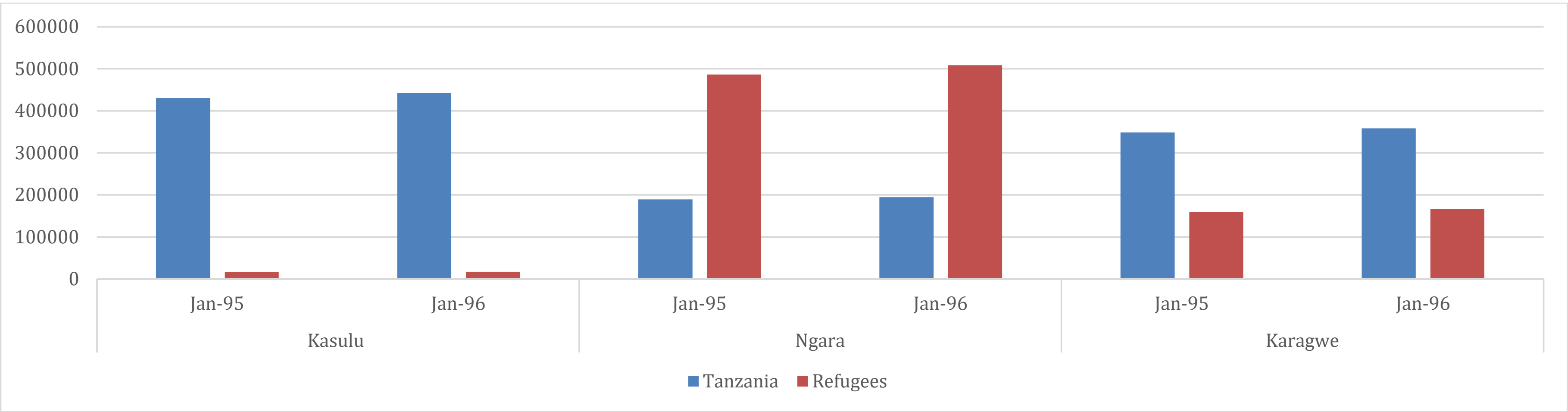
Source: UNHCR Population Statistics.

Table A2: Distribution of refugees and hosts in the most affected clusters of Kasulu, Ngara and Karagwe between January 1995 and January 1996

	Kasulu		Ngara		Karagwe	
	Jan-95	*Jan-96*	*Jan-95*	*Jan-96*	*Jan-95*	*Jan-96*
Tanzania	430,480	442,533	189,108	194,403	348,410	358,165
Refugees	16,423	17,162	486,300	508,183	159,610	166,792
Proportion	**3.82%**	**3.88%**	**257.15%**	**261.41%**	**45.81%**	**46.57%**
Total	446,903	459,695	675,408	702,586	508,020	524,957

Source: Mwakasege (1995) and Oxfam Tanzania Office Study report.

Figure A6: Distribution of refugees and hosts in the most affected clusters of Kasulu, Ngara and Karagwe in January 1995 and January 1996



Source: Mwakasege (1995) and Oxfam Tanzania Office Study report.

Table A3 - Definition of variables

Variables	Definition
Children characteristics	
Haz06	Height for Age Z score of under five years old children computed using the 2006 WHO New standards
Stunting	Probability of HAZ less than -2 SD (Standard Deviation)
Birth Order	Birth order of the children among siblings
Male	1 if the under five years old child is a male, 0 otherwise
Age	Child's number of months
Parents characteristics	
Secondary education or more	1 if the mother/father completes the secondary level of education, 0 otherwise
Land Ownership	1 if the mother/father owns land, 0 otherwise
House Ownership	1 if the mother/father owns a house, 0 otherwise
Currently working	1 if the mother/father is working at the time of the survey, 0 otherwise
Refugees' exposure variables	
Resid.	1 if the parents move into their place of residence before 2001 and 0 otherwise
R	Refugee Influx Index (Weighted sum of population divided by the distance to the 13 camps)
T_j^1	1=the Mother was born or exclusively spent her early childhood (0-5) during the refugee influx (1994-2001), 0=Otherwise
T_j^2	Total number of years a mother from the treatment cohort was exposed to refugees
T_j^3	Equal to 2 if the mother j of the child i was exclusively born or solely spent her early childhood (0-5) during the first phase of the refugees' inflow (1993-1996), 1 if the mother j of the child i was exclusively born or solely spent her early childhood during the second phase of refugee influx (1997-2001); and 0 otherwise
T_j^4	1=the Mother was born or exclusively spent her early childhood (0-5) during the refugee influx (1988-1993), 0=Otherwise (Excluding those born between 1993 and 2001)
T_j^5	1=the Mother was born or exclusively spent her early childhood (0-5) during the refugee influx (1988-1996), 0=Otherwise (Excluding those born after1996)