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Civil War and Economic Sanctions: An Analysis of Anthropometric Outcomes in Burundi

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This paper investigates the impact of the latest civil war and the subsequent economic embargo in Burundi on the health status of the Burundese children. We find that the civil war and the economic embargo had a particularly detrimental impact on the nutritional status of rural populations, due to a direct effect of the civil war and to the soaring of food prices during the embargo. A rural Burundese child who was affected by both shocks had a height-for-age of 1 standard deviation lower compared to a similar child who did not suffer from these 2 events. These shocks seem not to have affected the health status of urban children. In the analyses, we control for a variety of household and community characteristics using data from the 1998 household Priority Survey.

1 Introduction

The 1990s have been an extremely violent decade in the history of Central Africa. Several episodes of mass murder and genocide in Burundi and Rwanda, and the regionalized civil war in the Democratic Republic Of Congo have taken a heavy toll in terms of human lives and socio-economic destruction. In contrast to its war prone neighbours, Burundi has received relatively little attention in the international media as well as in academia. Most of the

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recent studies concerning Burundi focus on the causes of the latest episode of civil strife (Ngaruko and Nkurunziza, 2000) or the possible solutions to it (Ndikumana, 2000)[1]. Others give a very detailed description of the evolution of the crisis (Chrétien and Mukuri, 2000) or focus on the year by year political evolution (Reyntjens).

As for the *macro-economic impact* of the crisis is concerned, we consult the usual indicators [2]: between 1990 and 2002, income per capita fell from 210 US$ to about 110 US$, a decline of nearly 50%, leaving Burundi as the poorest country worldwide. The proportion of people living below the poverty line dramaticaly increased from 35% in 1992 to approximately 68% in 2002. Over two thirds of the Burundese population thus lives in absolute poverty. Moreover, international assistance froze during the crisis, declining from about 300 million US$ in 1992 to less than 100 million US$ in 2002. This situation is even further aggravated by the large number of displaced people and the spreading of HIV/AIDS.

Burundi has known three major events during the 1990s:

- The assasination of the president in October 1993 which erupted in high intensity civil war
- The total economic embargo imposed by the neighbouring countries in response to the coup d'etat by former President of the Third Republic Major Pierre Buyoya on July 25th 1996. The blockade was in place between August 1996 and January 1999
- The subregional civil war involving almost all countries in the Great Lakes region with DR Congo (which borders Burundi to the west) as the main battlefield

In this paper, we will try to quantify the impact of these shocks on the health status of the Burundese population. As stated in the University of Uppsala's yearly report on *States in Armed Conflict*, *'The health effect of conflict on civilian populations [...] is a little-researched field'* (Eck, 2003, p. 157). Generally it is assumed that the number of people killed in direct violence is relatively small compared to the number of deaths caused by

[1] The latest episode of civil war in Burundi erupted in October 1993, when the first democraticaly elected president Melchior Ndadaye, a Hutu, was assasinated by the Tutsi-dominated army. The crisis was the most severe in the history of Burundi both in terms of casualties and in duration.

[2] All figures based on Interim Poverty Reduction Strategy Paper, World Bank, 2003

the consequences of conflict, such as the breakdown of the economy and the health system and the spreading of infectious diseases among displaced people (WHO, 2002; Eck, 2003). As such, this study should be of interest to several audiences: it contributes to the literature on health effects of civil conflicts[3], and provides a hopefully valuable case study concerning the world's poorest country, the Republic of Burundi.

The paper proceeds as follows: the next section gives a brief overview of the history of violence in Burundi and sketches the spatial and temporal evolution of the latest crisis. Section 3 specifies a health demand fuction and derives the model that will be estimated, while Section 4 describes the variables that will be used in the analysis. Sections 5 and 6 present and discuss the results. The final section concludes.

2 The Burundese conflict

2.1 A short political history

The long history of civil conflict in Burundi began 3 years after independence from the Belgian colonial administration, in 1965, when a group of hutu-officers unsuccesfully tried to seize power and overthrow the monarchy. This failed coup-attempt led to a purge of hutu from the army and government bodies and marked the beginning of political exclusion of the hutu-majority by the tutsi-minority. Power now became the sole monopoly of tutsi, who, in their turn, effectively seized power in 1966 and proclaimed the First Republic, headed by capt. Micombero. During Micombero's regime, power became increasingly concentrated in the hands of a small ethno-regional group, the tutsi Hima-clan from the southern province of Bururi, what the French historian Chrétien (1997, p. 160) calls *'la maffia de bururi'*.

In 1972, a hutu-insurgency was launched in the southwest of Burundi, causing considerable loss of live among the tutsi-residents. The army repression that followed, was horrible: from may 1972 on, all actual and potential members of the hutu-elite were systematically physically eliminated. Lemarchand (1994, p. 97) writes:

> *'The carnage continued unabated until August. By then, almost every educated hutu was either dead or in exile.'*

This genocide of the educated hutu decapitated all present and future hutu-opposition for over a generation, and reduced the status of the hutu-people

[3]For the longer-term consequences of civil wars on the health of civilian populations, consult Ghobarah et al., 2003.

to that of an oppressed underclass.

The next episode of violent confrontation took place in 1988, when once again a hutu-insurgency was launched, this time in the north of the country[4]. As in 1972, army repression was swift and took an enormous toll on the local hutu-population. Contrary to 1972 however, the international community condemned the massacres and began to put intense pressure on the Buyoya-regime to liberalize its political system, leading to the elections of June 1993, the first free and fair elections in post-independence Burundi[5] . Unfortunately, this democratic transition was soon halted: In October 1993, the first democratically elected president Melchior Ndadaye, a hutu civilian, was assassinated by tutsi army elements in a failed coup attempt, marking the beginning of yet another civil war.

The spreading of the news of the assassination of the president to the rural provinces provoqued large-scale massacres of Tutsi-civilians and *uprona-hutu's* by their neighbour hutu peasants[6]. The severity of the massacres is clear in Chrétien, 1997, p. 172:

> *'Ces pogromes touchent des province entires (Karuzi, Kirundo, Bujumbura Rural). Des communes comme Rango, Ruhororo ou Mwumba (au Nord), comme Gishubi ou Mbuye (au centre du pays), sont pratiquement 'purifiees' de tout element tutsi.'*[7]

In a matter of days, approximately 100 000 Burundians lost their lives in what was later acknowledged as *acts of genocide* (United Nations, 1996; Ngaruko and Nkurunziza, 2000). The tutsi-army retaliated on the hutu population, marking the beginning of the most severe civil war in the history of Burundi, both in terms of human lives and socio-economic destruction.

This latest episode of civil war is in one crucial aspect different from the previous episodes: unlike the previous ones, which all started with a localized hutu-insurgency followed by severe and highly randomn army reprisals, the

[4]In the mean time, Micombero had been replaced in a palace-coup by col. Bagaza in 1976, who in his turn had been ousted in another bloodless coup in 1987 by maj. Buyoya. Both are tutsi's from Bururi.

[5]The elections resulted in a landslide victory for the opposition party *frodebu*, with 65 on 85 seats in Parliament and 64% of all votes in the presidential elections (Reyntjens, 1993).

[6]Uprona-hutu's are hutu's loyal to the former unique state party, uprona, and are therefore seen as traitors to the hutu-cause. For an overview of the carnage that followed the coup, consult Chrétien, 2000

[7]'These massacres affect entire provinces (Karuzi, Kirundo, Bujumbura Rural). Communes like Rango, Ruhohoro ou Mwumba (in the north), or Gishubi and Mbuye (in the centre of the country), are almost completely 'cleansed' of all tutsi-elements'.

Figure 1: Massacres in Burundi: October 1993 - December 1993

current crisis is a genuine war, opposing 2 armed and organised factions and affecting almost the entire country (Ndikumana, 2000).

2.2 The spatial and temporal intensity of the conflict

In our subsequent analysis of child malnutrition the exact timing and location of the civil war will play an important role. We therefore sketch the evolution of the crisis trough time and space as follows:

- October 1993 to December 1993: A failed coup d'etat followed by large-scale massacres in the north and the centre of the country (see figure 1)[8].
- January 1994 to July 1996: Spreading of civil war throughout the country (see figures 2 and 3).
- July 1996 to August 2000: The return of maj. Pierre Buyoya to power and the subsequent economic blockade between July 31 1996 and January 23 1999. Lowering intensity of the civil war and signing of the Arusha Peace Accords in 2000.

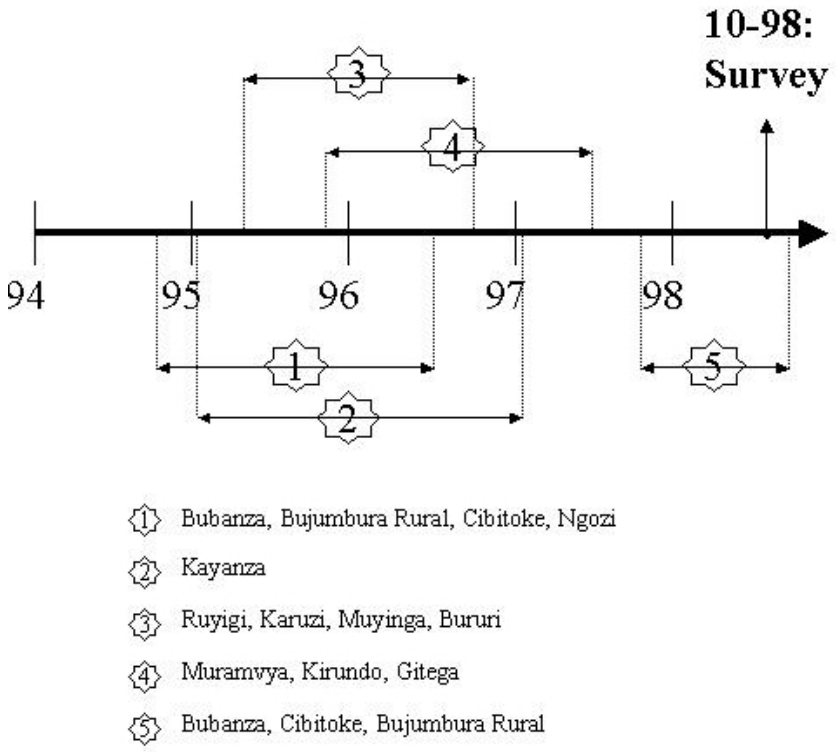
Figure 2 clarifies the evolution of the conflict[9]: guerilla warfare activity first erupted in October 1994 in the north-western provinces of Cibitoke, Bubanza, Bujumbura rural and Ngozi. By the beginning of 1995, violence spread to the bordering Kayanza province, and by march 1995, massacres of civilians and confrontations between the army and the rebel forces began to multiply in Karuzi, Bururi, Ruyigi and Muyinga. On march 27th, Burundi's interim president Sylvere Ntibantunganya announces the *beginning of a genocide* on a Belgian television station (Chrétien and mukuri, 2000, p. 95). By late 1995, the first acts of violence take place in the central provinces of Gitega and Muramvya and the northern province of Kirundo. The situation at the end of 1995 is depicted by figure 2. By then, the conflict had spread to almost the entire country, with exception of the provinces of Cankuzo (in the east of the country), Rutana, and Makamba (in the south of the country)[10]. A report of Médecins Sans Frontieres of December 1995

[8] Figures 1 and 3 are taken from Chrétien and Mukuri, 2000

[9] This reconstruction of the crisis is largely based on Chrétien and Mukuri, 2000 and United Nations, 1996.

[10] By the end of 1998, the Makamba province was hard hit by activities of insurgents operating from neigbouring Tanzania. Due to the generalized insecurity in this province, no data was obtained during the Priority Survey (EP, 1998).

Figure 2: Spatial and temporal intensity of the civil war

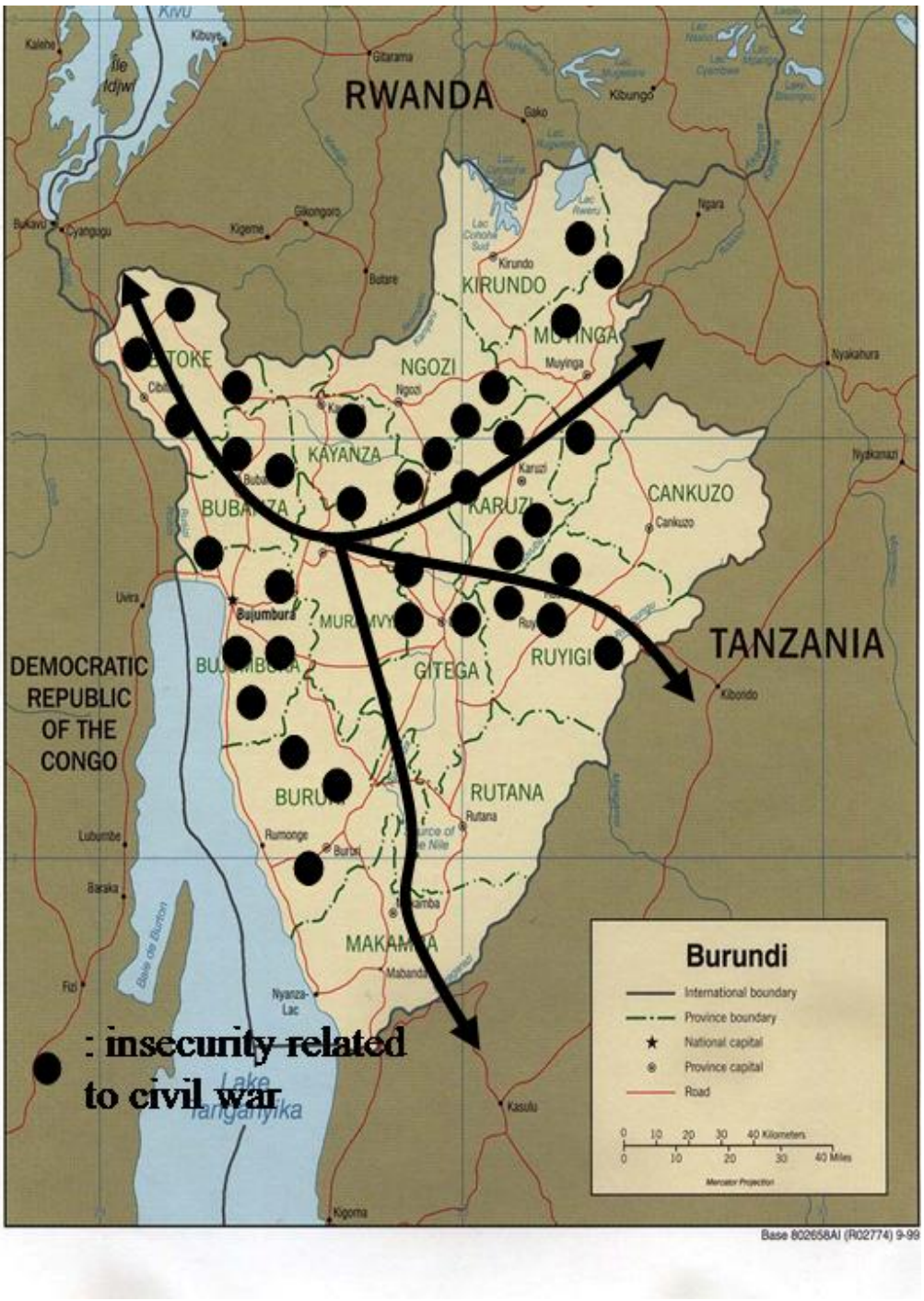


states a death toll of somewhere between 10000 and 15000 casualties in 1995 alone.

On july 25th 1996, former president Pierre Buyoya seizes power in a bloodless coup d'état, marking the beginning of the economic embargo which eventually lasted to january 23rd 1999. During the second half of 1996 and the first half of 1997, armed confrontations continued, especially in the provinces of Kayanza, Muramvya, Kirundo and Gitega. Meanwhile, the Arusha Peace talks between the principal parties engaged in the conflict had begun (the first session was held in April 1997). As of late 1997, insecurity increased again in Cibitoke, Bubanza and Bujumbura rural, provinces which remain unsafe until this very moment.

In the next section we present the health demand function that we will use to estimate the impact of the events described above on the health status of young children

Figure 3: Spreading of the civil war



3 The model

We will derive a health demand function, following Becker (1981) and Thomas et al. (1996). Assume that a household maximises a concave utility function which depends on the consumption of goods and services x_t, leisure l_t and the health status, θ_t of each member. Let anthropometric measurements, h_t be one dimension of the health status vector. The household chooses to

$$\max_{xl\theta} U(x_t, l_t, \theta_t; z_{ht}, \Phi_t) \tag{1}$$

where z_{ht} represents household characteristics and Φ_t respresents unobserved heterogeneity in preferences. Allocation choices are conditional on three constraints: a time and budget constraint as well as the constraints of a biological health production function[11]. In our study, we do not want to estimate the parameters of the health production function, but rather if and how exogenous shocks as well as community characteristics effect health outcomes. Solving for all choice variables in the optimisation problem leads to a reduced form anthropometric outcomes function:

$$h_{it} = g(z_i, z_h, y, z_c, \zeta_{it}) \tag{2}$$

where z_i represents individual characteristics and and z_c the set of all community characteristics such as availability of health services and food prices' effect on health outcomes which effect the health status directly, z_c^d as well as through input choices. By assumption, all covariates in (2) are exogenous. We also assume that ζ_{it}, which represents unobserved heterogeneity in anthropometric outcomes, is uncorrelated with the other elements of the demand function.

In the model, it is essential to control for household resources. Poor households often live in areas with poor health or market facilities in which case these community level variables may reflect household resources. We use expenditures to account for resource availability. We assume that leisure is (weakly) separable from commodity consumption and health in the utility function, in which case it is possible to derive a conditional demand function (Pollack, 1969) which is analogues to (2) but depends on total expenditure.

Lastly, we also control for household composition. One cannot treat it as exogenous in models of health of household members. Our control is rather crude as we use expenditures per capita, PCE as the indicator of resources

[11] We do not detail the entire model, as this can be found in the publications of above mentioned authors.

in the conditional demand function. Partition z_h into $\{\text{PCE}z_h^d\}$, then

$$h_{it} = h(z_i, PCE_t, z_h^d, z_c, \xi_i t) \tag{3}$$

This is the model that we will estimate for child anthropometric outcomes.

4 Data and description of variables

To study the anthropometric outcomes (and thus the health status) in Burundi, we use household data available from the Priority Survey carried out by the statistics department of the Government of the Republic of Burundi (ISTEEBU) in collaboration with the World Bank. The timing of the survey is particularly useful for our research: the survey was carried out between October 1998 and March 1999, which means that the oldest children in our sample (the children of 5 years old) were born during the exact beginning of the crisis. The timing of the survey also allows to investigate the possible effects of the economic embargo mentioned earlier.

From the Priority Survey of 1998, we have data on height, sex and age of 3098 children. After eliminating all cases for which no height had been recorded, and after excluding all children with probable measurement errors, we arrive at a final sample of 2575 children, of whom 1387 live in urban area's and the remaining 1188 in rural area's[12].

To study the impact of the civil war and the economic embargo on children's nutritional status in Burundi, we control for variables at the individual-, household- and the community level. At the individual level, we control for:

- **age**: The average age of the 2575 children in our sample is 30,87 months. There are no remarquable differences between urban and rural area's (30,64 vs. 31,13.
- **Gender**: 1324 children in our sample (or 51,4%) are female. In Bujumbura, this is 50,1% while in rural area's the girls account for 52,9% of the cases.

The variables at the household level are:

- **household size**: The mean household in our sample consists of 6,13 members. Split between rural and urban area's, the mean household size respectively amounts to 6,05 and 6,2.

[12]We adopt the approach of Alderman et al.(2004) in excluding all children with a z-score of either less than -6 or greater than 6.

- **gender head of household**: 84,6% of all households in our sample is headed by men. The remaining 15,4% is headed by women. Slightly more households in urban than in rural area's are led by women (16,6% versus 14,1%).

- **education head of household**: the median education in Burundi is the primary education. In rural area's, the median education level is in fact no education at all.

- **age head of household**: The mean age of the head of household is 38,54 years. There are no remarkable differences between urban and rural area's.

- **per capita expenditure**: The mean per capita expenditure in our sample amounts to 11756,91 Francs Burundais. There is an enormous disparity between urban and rural area's, the latter households being a lot poorer (17379,08 versus 5035,16).

- **marital status**: this variable was recoded into 2 groups, whether the head of household is married or not. 87,1% of the heads of household are married. In Bujumbura, there are more single heads than in rural area's (14,6% versus 10,8%).

At the community-level, we control for:

- **time to get to the nearest market**: the median time to get to the nearest market on foot lies between 15 and 30 minutes. In the capital city of Bujumbura this median time is less than 15 minutes. In rural area's however, this median time lies between 30 minutes and 1 hour.

- **time to get to the nearest drinking water point**: the median time to get to the nearest drinking water spot on foot is less than 15 minutes. 62,4% off all rural households have to walk less than 15 minutes to get drinking water. In Bujumbura, this amounts to 85,4% of households.

- **time to get to the nearest health center**:the median time to get to the nearest health center on foot lies between 15 and 30 minutes. In urban area's, this median time is less then 15 minutes. In rural zones however, 40% of households have to walk more than 1 hour to get to the nearest health center. 10% of them even have to walk between 2 hours and half a day.

In order to properly address the effects of the 2 shocks on children's nutritional status, we construct a civil war-variabele and an embargo-variable:

- **civil war**: As already shown in section 2.2, the crisis varried in spatial and temporal intensity. Therefore, we have traced for each province the most intense period(s) of the civil war (see figure 2)[13]. When a child in a certain province was in his/her crucial growth period (that is, between 6 and 24 months of age) during the intense period of the conflict, we coded the civil war dummy for this child as 1[14]. When a child was older during the intense period, or was not at all affected by the conflict, we coded the variabele for him/her as 0. In this manner, we work in 2 dimensions: spatial (we consider the various provinces and/or communes seperately) and temporal (within each spatial unit, we consider one or more intense period(s) of the conflict). Of the 1170 rural children in our sample, 360 were affected by the conflict during their crucial growth period and were assigned a value of 1.

- **economic embargo**

  To see whether the embargo had any impact on the children's health status, we use a slightly more sofisticated approach: we calculate for each child the number of months in the crucial period the child has suffered from the embargo and express this as a percentage. Obviously, the maximum number of months a child can suffer from the embargo during his/her crucial growth period is 18 (the full length of the crucial period), which corresponds to 100%. When the embargo affects the child for only 12 months during this crucial period, this percentage is 66,67 etc...[15] In our sample, the embargo variable has a mean of 53,19% and a standard deviation of 37,37%.

As an alternative measure for the effect of the embargo, we use data on food prices for the period 1990-1998. Unfortunately, only national data could be obtained[16]. We selected 4 major crops in the Burundese diet: bananas, dry beans, sweet potatoes and maize (according to the Food and Agricultural

[13] Most information was obtained from Chrétien and Mukuri, 2000 and United Nations, 1998

[14] Relevant literature suggests that growth retardation usually occurs between 6 months and 2 years of age (Verwimp, 2003).

[15] For example: a child who was born on October 1st 1995 entered his/her crucial period on April 1st 1996. Since the embargo only began to take hold as of July 31 1996, the child suffered 14 months during the crucial period. The embargo variable thus takes on a value of 77,78.

[16] Price data were collected by the statistics institute of Burundi, ISTEEBU.

Organization, these crops were the most important during the 1990s. See www.fao.org). For each crop and for each year, we calculated the deflated price using 1990 as base year (see table 1). Each child was then confronted with the average deflated price during the period he/she lived[17].

Table 1: Deflated prices of major food crops; base year = 1990. Authors' calculations

	1993	1994	1995	1996	1997	1998
Bananas	14,12	17,10	13,53	11,90	13,05	14,33
Sweet Potatoes	13,34	14,47	11,97	9,52	10,58	12,62
Maize	21,97	21,71	19,25	17,46	23,99	26,95
Beans	29,03	30,26	29,66	26,19	37,04	38,89

Finally, we measure the nutritional status of children between 6 and 59 months of age (the dependent variable) by looking at their heigt conditional on age and sex[18].The nutritional status of children is a good indicator of the nutritional situation of the general population:*'Les enfants constituent un groupe tres sensible aux différents changements d'alimentation et de nutrition et manifeste précocement les signes de carences éventuelles'* (EP, 1998). In order to make international comparison possible, we standardize this height for age variable using the parameters of the height for age curves of well nourished children in the United States[19]. In this manner, we obtain *heigt for age z-scores*, which we will use as an indicator of children's health status.

5 First findings

Let us first take a look at the provincial disparities in nutritional status[20]. Table 1 shows for each province the mean height for age z-score and the

[17]When a child was e.g. born in 1995, we computed the average deflated price of e.g. bananas over the years 1995-1998.

[18]We adopt the methodology used by several authors and consider anthropometric outcomes of children under 5 years of age to be a good reflection of their nutritional status. See Thomas et al., 1996.

[19]This data is available at the National Center for Health statistics (NCHS)

[20]We have excluded the provinces of Bubanza and Bujumbura rural from the analysis since only 9 children were considered in each province. The mean z-scores in these provinces were, respectively,-2,31 and -3,19

incidence of malnutrition[21]. A first striking observation at this point is the sheer magnitude of malnutrition in Burundi: over 55% of all children in Burundi are stunted. The situation is specifically dramatic in the rural area's, where almost 60% of all children suffer from some degree of malnourishment. The incidence of malnutrition in Burundi is substiantally higher than the average incidence in sub-saharan Africa, which amounted to 33% during the 1990s (World Bank, 2000). The average height-for-age z-score in Burundi is -2,14, which means that an average Burundian child has a heigt-for-age which is 2,14 standard deviations lower than an average well nourished child in the U.S. Note the particularly worrying *depth* of malnutrition in Burundi: about 30% of children are severely malnourished, versus 25,7% who suffer 'only' from a moderate form of malnutrition.

Table 1: Anthropometric indicators and malnutrition per province.

Province	n	hfaz	not mal.(%)	mod. mal.(%)	sev. mal.(%)
Bururi	105	-1,68	63,8	16,2	20,0
Cankuzo	43	-2,21	46,5	18,6	34,9
Cibitoke	34	-1,56	61,8	17,6	20,6
Gitega	163	-2,40	35,0	35,0	30,0
Karuzi	85	-2,36	40,0	20,0	40,0
Kayanza	144	-2,67	25,0	36,8	38,2
Kirundo	87	-2,45	34,5	32,2	33,3
Muramvia	109	-1,94	51,4	25,7	22,9
Muyinga	121	-2,23	43,0	22,3	34,7
Ngozi	149	-2,58	31,8	29,7	38,5
Rutana	65	-1,95	47,7	24,6	27,7
Ruyigi	65	-2,43	38,5	23	38,5
Rural Burundi	1170	-2,28	40,6	26,7	32,7
Bujumbura Mairie	1387	-1,02	73,0	13,7	13,3
Burundi	2557	-2,14	44,4	25,7	29,9

Table 3 presents the results of 2 weighted least squares regression analyses[22]. The first analysis shows the results for the rural area's. As to what concerns the individual characteristics, we note a strong sex-effect, significant at the 1% level: being a girl in rural Burundi associates with a better

[21]The incidence of malnutrition is split into 3 groups: not malnourished (z-score $\geq$ -2), moderately malnourished (-3 $\leq$ z-score $<$ -2) and severely malnourished (z-score $<$ -3)

[22]The data are weighted by the sample weights provided for by the survey

nutritional status. Also, the older a child gets, the worse its z-score (negative coefficient on the age-variable). When we look at the squared values of the age-variable, we see that the age-squared variable has the opposite (positive) sign than the age variable. Thus: the older a young child gets, the worse its z-score; the older an 'old' child gets, the better its z-score[23].

At the household level, the education of the head of the household strongly positively influences the health status of the children of the household. Surprisingly however, the per capita expenditure of the household is not significantly related to the z-score of the household's children. Whereas most research shows that income or expenditures are statistically significant in a regression analysis of height-for-age, that research is seldomly performed in war affected economies. It could be that in those economies, such as rural Burundi, households have suffered so much from the civil war that even income or expenditures do not affect child health status anymore[24]. As to what concerns the community-level, none of the variables is significant in the rural analysis.

These above mentioned relationships are not, however, the focus of our study. The civil war shock is, and this seems to have had a detrimental impact on children's nutritional status: children who were affected by the civil war during their crucial growth period had at the time of the survey a height-for-age z-score which is, ceteris paribus, 0,442 lower than other children.

The second regression of table 2 shows the separate results for the capital city of Bujumbura. As in the rural analysis, we notice the typical U-shaped age effect on nutritional status. We also find a similar sex-effect, meaning that girls in Burundi have a better nutritional status than boys. At the household level, both the level of education of the head of household and the per capita expenditure have a strong positive impact on the nutritional status of children in the household. Also, the marital status-variable becomes marginally significant (p-value = 0,094): when the head of the household is married, the child has a better nutritional status.

What concerns the community-variables, we see that the time to get to the nearest drinking water point becomes significant at the 1 % level: the higher this time, the lower the child's z-score. The other variables at the community level seem to have a negative, though not significant, influence

[23]This is one of the most documented effects on children's nutritional status in developing countries (Verwimp, 2003).

[24]Even if we exclude education from the analysis, the pce-variable remains totally insignificant.

Table 2: Determinants of anthropometric outcomes in Burundi. Height for age z-score dependent variable.

	R1	R2
individual characteristics	Rural	Urban
age	-0,070***	-0,028*
	(0,013)	(0,015)
agesq	0,001***	0,001**
	(0,000)	(0,000)
sex	0,308***	0,231**
	(0,084)	(0,098)
household characteristics		
education	0,293***	0,193***
	(0,077)	(0,049)
ln pce	0,002	0,324***
	(0,056)	(0,083)
sexhh	0,146	0,256
	(0,165)	(0,231)
agehh	0,000	0,005
	(0,004)	(0,005)
married	0,054	0,413*
	(0,184)	(0,247)
community characteristics		
time market	0,032	-0,028
	(0,044)	(0,095)
time drinking water	0,047	-0,087***
	(0,032)	(0,027)
time health center	-0,041	-0,071
	(0,043)	(0,077)
shocks		
civil war	-0,442***	
	(0,133)	
embargo		
constant	-2,206***	-5,344***
	(0,628)	(0,944)
R^2_{adj}	0,079	0,080

***: significant at 1% level
**: significant at 5% level
* : significant at 10% level

on the child's health situation. Since Bujumbura has never been the scene of open warfare, we have excluded the civil war-variable from the urban analysis[25].

6 The impact of the economic embargo

So far, we have not included the embargo variable in the analysis. Obviously, and due to the specific construction of the embargo-variable (see section 4), there is a great deal of multicollinearity going on between the 2 age-variables and the embargo-variable. The tolerance values of age, agesq and embargo, when included together in a regression analysis, are respectively 0,003, 0,003 and 0,069, which is, by rule of thumb, not acceptable. In case of multicollinearity, the regression coefficients cannot be estimated with great precision (Gujarati, 2003). Since it is the purpose of our study to estimate the health effects of the civil war and the economic embargo with *reasonable* precision, we cannot continue with such a strong presence of multicollinearity. Therefore, we exclude the variable which correlates the most with the embargo-variable,that is, age-squared (correlation between embargo and age: -0,110; correlation between embargo and agesq: -0,311). The tolerance values of age and embargo without agesq in the regression analysis are 0,487 and 0,872, which are sufficiently high.

The first regression (R3) again shows the results for rural Burundi. We notice that the economic blockade had a strong negative health effect, significant at the 1% level: children who were affected by the embargo during their full crucial growth period (embargo-variable = 100) had at the time of the survey a z-score which was, ceteris paribus, 0,5 lower compared with children who did not at all suffer from the economic sanctions (embargo-variable = 0). In urban Bujumbura (R4), the embargo seems to have had a negative though insignificant effect on children's nutritional status.

It is likely that the embargo played out its effects through the soaring of food prices on local markets. According to a UN report, the price of salt, which is a leading indicator of the local market, had already tripled by August 7 1996 as the sactions began to take hold (UN, 1996). The last regression in table 3 (R5) accounts for these price increases. In R5, we consider Burundi as a whole and add a regional dummy-variable, taking on 0 in urban area's and 1 in rural area's. Note that the negative health-effect of living in rural area's is very strong, as we already had seen in table 1. When

[25]Randomn killings and political assassinations did occur in Bujumbura, allbeit on a far smaller scale than the open war in the countryside.

Table 3: Determinants of anthropometric outcomes In Burundi (bis). Height for age z -score dependent variable

	R3	R4	R5
individual characteristics	Rural	Urban	Burundi
age	-0,012***	0,005*	-0,078***
	(0,004)	(0,003)	(0,022)
sex	0,304***	0,233**	0,297***
	(0,084)	(0,098)	(0,058)
household characteristics			
education	0,292***	0,189***	0,290***
	(0,077)	(0,049)	(0,044)
ln pce	0,003	0,321***	0,033
	(0,056)	(0,083)	(0,039)
sexhh	0,145	0,251	0,122
	(0,165)	(0,231)	(0,116)
agehh	0,000	0,005	0,000
	(0,004)	(0,005)	(0,003)
married	0,063	0,397	0,052
	(0,184)	(0,247)	(0,129)
community characteristics			
time market	0,030	-0,035	0,031
	(0,044)	(0,095)	(0,032)
time drinking water	0,048	-0,082***	0,026
	(0,032)	(0,027)	(0,022)
time health center	-0,040	-0,067	-0,038
	(0,043)	(0,077)	(0,031)
Regional dummy			-0,541***
			(0,138)
shocks			
civil war	-0,461***		-0,565***
	(0,135)		(0,094)
embargo	-0,005***	-0,002	
	(0,001)	(0,001)	
prices			
bananas			-0,384
			(0,385)
maize			0,018
			(0,081)
beans			-0,091***
			(0,032)
sweet potatoes			0,328
			(0,307)
constant	-2,594***	-5,571***	2,705
	(0,613)	(0,938)	(2,517)
R^2_{adj}	0,079	0,078	0,134

we look at the prices, we find that only the price of beans seems to have had a strong negative impact on the height-for-age z-scores. Since beans are a very important ingedient in the Burundi diet and most beans have to be imported from neighbouring countries, it is likely that the effect of the embargo is channeled through the rising price of beans[26]. Note that the adverse health effect of the civil war remains very important and significant (coefficient of -0,565).

In order to illustrate the results of the analysis, we carried out a binary logistic regression -results of which are not included in this study- with the covariates listed in R5 (we however did replace the 4 price variables with the embargo variable)[27]. Results show that a hypothetical child with all the *worst* characteristics in our sample has a probability of being malnourished of 93,41% , while an equally hypothetical child with all the *best* characteristics would have a risk on malnutrition of only 6,38%[28]. To isolate the effect of the civil war, we keep all regressors fixed at their mean value and let the war dummy take on a value of subsequently 0 and 1[29]. The average boy who was during his crucial growth period heavily affected by the civil war had a risk of being malnourished of 69,48%, while his average collegue not affected by the war had a probility of malnutrition of more than 20% lower (47,52%). To grasp the effects of the economic embargo, we carry out a similar simulation[30]: the average boy who did not suffer the consequences of the embargo had a probability of being malnourished of 61,07%, while his average brother who was fully affected (i.e. during the full length of the crucial period) by the sanctions had a 78,76% risk of being malnourished, which means an increase of over 17%. Finally, an average urban boy who did not experience economic sanctions nor civil war had a 36,06% probability of being malnourished, while his average rural nephew affected by civil war and economic sanctions had a risk on malnutrition of 82,73%.

[26] Whereas many households cultivate beans, their own production is much too low to cover their consumption.

[27] We consider a dummy dependent variable: 0 = not malnourished; 1 = malnourished.

[28] The *best* characteristics are the values of the regressors which minimize the probability of being malnourished and vice versa.

[29] Since nominal dummy variables have no mean, we carry out the simulation for a rural boy with a married father.

[30] The simulation is again carried out for a rural boy with a married father. We assume that these hypothetical boys experienced civil war.

7 Conclusions

In the previous sections we have argued that the Republic of Burundi has known 3 major shocks during the 1990s, and we have made an attempt to quantify the impact of these shocks on the health situation of the Burundese population. Generally speaking, if one accepts the nutritional status of children between 6 and 59 months (a most vulnerable group) as an indicator for the health status of the overall population, this health situation is far from good: 42,4% of all children suffer from some degree of malnutrition (from moderate to severe), and this figure increases to an astonishing 59,4% in rural area's alone.

We have shown that the civil war in which Burundi is embroiled since the end of 1993 has had a particularly detrimental impact on the health status of rural children. It is therefore likely that the 12-year civil war, apart from having made casualties in *direct* violence, has killed and will continue to kill *indirectly*, through the serious deterioration of the health status of rural civilians. The empirical results presented in this study thus support the conclusion of Ghobarah et al. (2003) that civil wars cause considerable 'collateral damage' among civilian populations.

As to what concerns the effects of the two-year-and-a-half economic embargo, we agree with the conclusion of André, that *'the rural population pays the price'*(André, 1997, p. 1). We argue that the embargo played out its effects through the rising of prices on local food markets, price increases which the already seriously impoverished rural people could not afford. Especially the soaring prices of beans, an imported and important ingredient in the Burundese diet, had a detrimental impact on the nutritional situation of the rural population.

In short, a Burundese child who experienced the full effects of the economic embargo and was affected by the civil war had (in 1998), on average, a height-for-age which was approximately 1 standard deviation lower than a child who did not suffer from any of the aforementioned shocks.

Finally, the bad nutritional status of Burundese children holds a perverse promise for the future. If recent work by Alderman et al. (2004) or not so recent work by Behrman (1996) proves valid for all countries, the future human capital formation in Burundi could be seriously adversely affected by the current low levels of nutritional intake.

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