Conflict, Child Health, and Household Adjustments in Eritrea

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Abstract

Child stunting in growth currently affects 164 million children globally, and has dire consequences for the future well-being of the affected children (Milman, Frongillo, de Onis, and Hwang, 2005). Wars disproportionately affect children and is believed to raise levels of stunting due to malnutrition and diseases. Using the 2002 Eritrean Demographic and Health Survey, this thesis adopts a differences-in-differences methodology and finds that the 1998-2000 border war raised levels of stunting in affected regions by 12 %, which is more than a quarter of the non-conflict level. A second investigation studies idiosyncratic war-related shocks, and does not find any significant and negative effects on child stunting from mobilisation, war-related deaths among male family members, and displacement still ongoing in 2002. Thirdly, this thesis finds that the levels of stunting among children in the Debub region were significantly more severely affected by conflict if living closer to a main road, indicating that dependency on trade with Ethiopia was an important risk factor.

This thesis argues for a few methodological improvements to a paper by Akresh, Lucchetti, and Thirumurthy (2010) on the relationship between the Eritrean-Ethiopian border war and child growth. It argues for studying child stunting in growth rather than height-for-age Z-scores, as the effects of conflict operating through food shortages, a deteriorating health environment or changes in maternal and child care are only hypothesised to affect the former. It furthermore identifies and tackles multicollinearity problems in the previous study by improving controls on child age and other confounding variables. Another highlighted problem relates to robustness in the conflict indicator of the Akresh, Lucchetti, and Thirumurthy (2010) study which uses distance to three war sites. However, it is here argued that the problem is due to regression misspecifications rather than the conflict indicator itself, and the thesis comes short of finding a convincing usage of the ACLED database to replace it.

The analysis of coping strategies in this thesis further develops the idea that the conflict-stunting relationship is asymmetric and highly influenced by the options available to households in mitigating the effects of negative shocks. An analysis is provided on how households adapted production patterns, asset holdings and fertility to cope with the constraints created by the conflict, and how they made use of supportive networks. Of particular interest is the role of Eritrean women in mitigating the effects of war. Eritrean women have to a significant degree substituted for the labour of men in general, and also for mobilised men. The level of fertility during the 1998-2002 time period was lower in families that were not able to secure the basic needs of their last-born child still alive, of which stunting is a manifestation. Mothers of stunted children have furthermore wanted to postpone further childbearing which implies that a significant part of the reduction has been a desired adjustment for the mothers, yet they have not necessarily reduced their overall fertility desires. Consistent with economic theory, community assistance or mutual insurance systems do a much better job in mitigating crises with repeated risk exposure and when facing idiosyncratic risk than in an extraordinary conflict situation. Stunting due to war is significantly more dependent upon the ability to convert own wealth into emergency consumption and on growing own crops than stunting due to other causes. These findings point to a breakdown in social contracts during war, which is particularly problematic for the most vulnerable.

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1 Introduction

Child stunting in growth currently affects 164 million children globally, and has dire consequences for the future well-being of the affected children (Milman, Frongillo, de Onis, and Hwang, 2005). It is associated with increased risks of mortality and disease both in childhood and adult life, negatively affects children's cognitive development, and is not only a consequence but also a cause of poverty (UNICEF, 1998). Wars disproportionately affect children and is believed to raise levels of stunting due to malnutrition and diseases, although the extent of the impact is not clear (Milman, Frongillo, de Onis, and Hwang, 2005). That so little is known about the effects of conflict on stunting reflects that scholars have paid very little attention to the consequences of conflict and in particular its social consequences (Iqbal, 2010).

This thesis will analyse the effect of the 1998-2000 border war between Ethiopia and Eritrea on stunting of Eritrean children. A further investigation will aim for a more thorough explanation of how households adapted production patterns, asset holdings and fertility to cope with the constraints created by the conflict, and how they made use of supportive networks. The principle motivation for the thesis is to better understand the consequences of and adaptations to conflict for Eritrean households, which could be of relevance to rehabilitation efforts still ongoing and for preparedness for the unfortunate possibility of a resumption of hostilities. Studying these effects are also important for an understanding of the long-term consequences of the 1998-2000 border war. Furthermore, as a reflection of emergency consumption, studying war-time child stunting and its determinants may deepen our understanding of food security in Eritrea and how it may be improved.

A second motivation is to contribute to the theoretical and methodological discussion regarding conflict and child stunting. The thesis uses several spacial methods for studying the effect of the border war on child stunting not attempted before, such as the recent Armed Conflict Location and Events Dataset from PRIO (Raleigh, Linke, Hegre, and Karlsen, 2010), an inductive method, and locations in relation to major roads. Secondly, the thesis questions the robustness of a previous study of the impact of the border war on child growth on theoretical and methodological grounds. Perhaps most interesting is the depth to which the conflict-stunting relation is investigated, and in particular how various adaptation strategies undertaken by households and women have mitigated the effects.

This thesis is organised as follows. Chapter two presents a model for studying the causes of child stunting, and theorises possible coping strategies. Chapter three starts with a replication of a previous study by Akresh, Lucchetti, and Thirumurthy (2010), and then develops a number of critiques to the paper. These critiques inform chapter four where improved models of the impact of conflict on stunting are presented. The fifth chapter is dedicated to an investigation of how wealth, production patterns, community assistance systems and fertility levels were altered by households in order to cope with constraints created by conflict.

1.1 The 1998-2000 border war

The border war between Ethiopia and Eritrea lasted from May 1998 to December 2000 and resulted in the loss of more than 70.000 lives and the displacement of 1/3 of the Eritrean population (Jacquin-Berdal, 2004). It was the only interstate war in Africa during the 1990s, as civil wars have been much more frequent since the end of the cold war (Anderton and Carter, 2009; Jacquin-Berdal, 2004). It followed a short period of peace between the two nations after the 1974-1991 independence war, where the Eritrean People's Liberation Front (EPLF) and the Tigray People's Liberation Front (TPLF) fought the Derg together, ending with the independence of Eritrea under president Isaias Afwerki and the TPLF gaining power in Ethiopia under president Meles Zenawi (Plaut, 2004). The reasons for long-term comrades in war with shared ethnic backgrounds to wage war are not easily understood (Jacquin-Berdal, 2004). Hostilities started after the introduction of the Eritrean currency, the Nakfa, in 1997. Different currencies created a need for defined borders, and Ethiopia saw its trade interests and access to the Red Sea threatened. For Eritrea, defending its border claims was regarded as essential to secure the sovereignty of the newly independent state against a regional power and former colonist. More profound arguments further point to differences between the two movements in ideology and identity, where the Eritrean notion of nationality overrides its multi-ethnic composition whereas regional autonomy along ethnic lines defines the federal Ethiopian system.

The border war that followed was to a large extent fought in trenches on the border with large losses of soldiers on both sides, leading many to draw analogies to World War I (Jacquin-Berdal, 2004). Civilians were for the most part not directly targeted, although bombardments did take place. The displacement of a large share of the population had a severe impact on civilian livelihoods. It is furthermore important to consider that the war was fought between two of the poorest and most food insecure countries in the world, due to a dry climate and decades of war with depletory effects on the natural environment (White, 2005). A combination of drought, conflict and underdevelopment caused a food crisis in Eritrea, leaving up to 600.000 persons in need of humanitarian assistance during the war.

1.2 Data

The favourable timing of a Demographic and Health Survey (DHS) in 2002 makes anthropometric data available on children born before, during and after the border war in the same survey. This pseudo panel creates a unique opportunity for understanding how a population is affected by conflict, as has been exploited by Akresh, Lucchetti, and Thirumurthy (2010). The 2002 DHS was conducted between March and July 2002 by ORC Macro and the National Statistics Office of Eritrea. It includes a sample of 9824 households, and the height and age of 5612 children aged 0-5 at the time of interview are recorded.

For conflict data, the Armed Conflict Location and Events Dataset (ACLED) contains 385 conflict events of the Eritrean-Ethiopian border war, with 96.183 fatalities. These events are based on press reports, which poses a challenge for the quality and precision of the data (Bocquier and Maupeu, 2005). The media on both sides of the border were not able to conduct or verify counts of deaths or cover all incidents during the war (Last, 2004), and both locations and the number of deaths may thus be inaccurate. A further problem is that of correct coding of events from often ambiguous or inaccurate descriptions, based on maps with limited coverage of names of smaller locations, and working with local names from several languages and alphabets. A closer inspection of all locations remotely placed or with more than 100 casualties led to the identification of some events that are certainly misplaced. New locations are found using available literature, bearing in mind that the original news sources were not available. A full explanation of all changes are shown in Appendix A.

I have used Stata 11 and Stata 12 for statistics and regression analyses, and ArcGIS 9.3 for spacial estimations. Maps on administrative areas and roads are taken from DIVA-GIS developed by Hijmans (2012). WHO Child Growth Standards were calculated using the WHO Anthro software (World Health Organization, 2010).

2 Conflict, child health, and household behaviour

This chapter starts with a clarification of the anthropometric measures that will be used in this thesis, and presents a framework for studying causes of stunting in child growth. The framework is then related to hypotheses of how the border war has affected stunting in Eritrea. In the last section, theories of different coping strategies adopted by the households during war are discussed, including an economic theory of how mutual insurance systems are likely to have been affected by conflict.

2.1 Concepts and theories of growth stunting

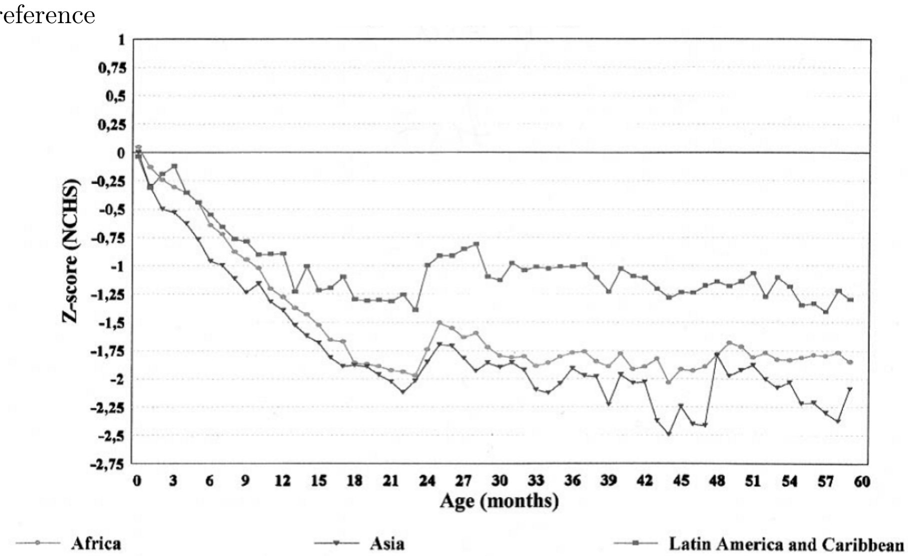
In DHS surveys, data is collected on the height and age of all children under the age of five. Such data can then be compared to the distribution in height of a healthy population of the same age, with the U.S. National Center for Health Statistics (NCHS) standard being used in this case (National Statistics Office of Eritrea and ORC Macro, 2003). This has allowed for the creation of height-for-age Z-scores. If the height for age falls below minus two standard deviations from the mean of the healthy reference group (approximately within the shortest 2.3 %), a child is considered stunted. Growth stunting is generally used as an indicator of chronic malnutrition of children although other factors also play a role, whereas wasting (low weight-for-height) is considered a symptom of acute malnutrition (Lewit and Kerrebrock, 1997).

The NCHS standard for children under two years is based on the Fels study of infant formula fed US children of restricted genetic, geographical and socio-economic background from 1929 to 1975 (Dibley, Staehling, Nieburg, and Trowbridge, 1987). For children older than two years, it is based on three representative surveys conducted in the USA from 1960 to 1975. It has a number of known drawbacks (see World Health Organization (1995) for discussion). The scale is discontinuous at 24 months, and its limited geographic scope questions the justification for its usage as a reference. The more recent WHO Child Growth Standards are much more reliable, as they are based on children whose diet has followed the WHO recommendations in six countries in different regions (World Health Organization, 2009). The benefit of using the NCHS reference is that the study in this thesis thereby becomes comparable to work done by others. This should not create problems for the qualitative and relative results, yet is affecting quantitative measures. For comparison, the WHO Child Growth

Standards Z-scores were also calculated, based on DHS data on the height and age measured in days. By running regressions using the WHO Child Growth Standards, I was able to verify that the effects reported in this thesis were also present in this case.

The most important control when studying how height for age differs between children in a malnourished population is to take into account how the probability of having a deviating height changes with the age of a child. Children generally show very little variation in length at birth. Malnutrition thereafter has a cumulative effect on young children until they reach 2-3 years, reflecting a 'continuing process of failing to grow' (World Health Organization, 1995). Children above that age tend to remain short for their age with means running parallel to the reference group, as they are 'in a state of having failed to grow'. Shrimpton, Victora, de Onis, Lima, Blössner, and Clugston (2001) systematically assess the worldwide timing of growth faltering, and figure 1 illustrates well that average levels of deviation can be approximated by a decreasing linear trend followed by a parallel linear trend in malnourished societies.

Figure 1: Mean height for age z-scores by age and region, relative to NCHS reference



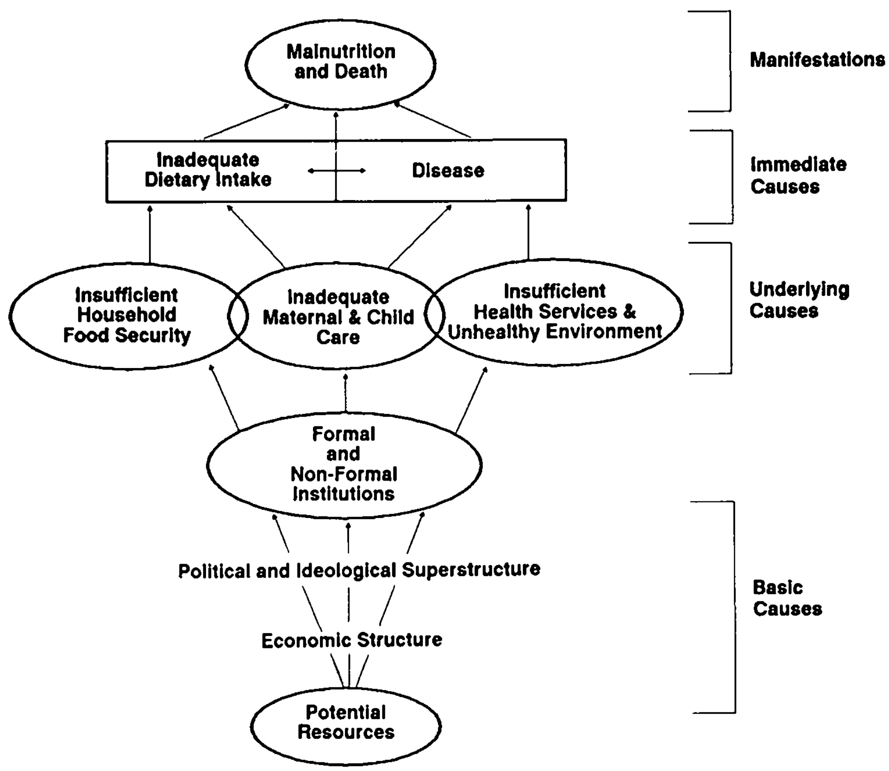
Source: Shrimpton, Victora, de Onis, Lima, Blössner, and Clugston (2001)

The causes of growth stunting are due much more to social, demographic and economic factors than to genetics (Frongillo, de Onis, and Hanson, 1997), which justifies the social approach to stunting that this thesis is built on. Yet social and genetic factors are generally difficult to separate, for instance with the (relatively minor) ethnic variation found in height for age (Frongillo and Hanson, 1995). Feeding practice is another factor affecting child growth, where breast-fed infants in favourable conditions are shorter than the NCHS standard, yet experience higher chances of survival and reduced incidence of infectious deceases, especially in developing countries (World Health Organization, 1995). The heights of boys are globally and for healthy children greater than those of girls (World Health Organization, 1995) yet the opposite is found across sub-Saharan Africa (Wamani, Astrom, Peterson, Tumwine, and Tylleskar, 2007), and birth size and intrauterine growth affect later child growth. Being born in high altitudes reduces birth weight and thus later growth. A strong determinant of child height is parental height, which is associated with both birth weight and later childhood growth, again reflecting a combination of genetics and socio-economic conditions due to historic deprivations.

Taking these factors into account, the focus of the thesis remains on the social causes of stunting, and how these causes are related to the border war. A framework for studying the causes of malnutrition and death of children has been developed by UNICEF (1990) and adopted to the study of variability among nations in child growth by Frongillo and Hanson (1995) and growth stunting by Milman, Frongillo, de Onis, and Hwang (2005). It is illustrated in figure 2. The framework allows for a distinction between manifestations (malnutrition, death and growth stunting) and their immediate, underlying and basic causes. The immediate causes of growth stunting are inadequate dietary intake and diseases. These not only influence child growth, but also influence each other. There is not sufficient data to determine which of these two causes have influenced child health in Eritrea.

Underlying causes concern the fulfillment of specific basic needs of children (UNICEF, 1990). They can be grouped into three main clusters: food security, maternal and child care, and health services and environment. The household's ability to secure sufficient and healthy food and provide for health services and a healthy environment for their children are prerequisites for the dietary intake and health of a child. Health services and environment can be observed by indicators such as access to health care, access to safe water, and immunisation rate. Yet importance should also be placed on systems that ensure that the households' resources are used for the benefit of children and their mothers. These factors are partially observable through female education and literacy rate, or

Figure 2: Causes of malnutrition and death



Source: UNICEF (1990)

through the women's involvement in financial decision-making or attitudes to wife beating.

Just as the underlying causes influence growth through the immediate causes, there are a number of basic causes at the societal level that influence the underlying causes. The basic causes can be grouped in order of proximity to the underlying causes. The arrows between them in figure 2 are meant to reflect this order, and should not be interpreted as indicating deterministic causal linkages. Formal institutions are mostly thought of as provided by the government (most notably education and health care systems), whereas non-formal institutions may be provided by the community, religious groups, family networks or households. Non-formal institutions of particular interest are community and household/individual insurance systems, earning opportunities and markets. These formal and non-formal institutions are again shaped by political and ideological structures, where norms governing women's position and the responsiveness of government have been found to be important. UNICEF (1990) further states that most of the underlying causes are the result of unequal distribution of resources in society, which again is shaped by the historical background of a society and its resource potential.

For this study, the conceptual framework serves two main functions. First of all, all hypotheses that will be developed on how conflict influences child growth will operate through the underlying causes. Ultimately, a combination of the underlying causes will influence child growth, and distinguishing between them is not the aim of the thesis. Yet bearing these underlying causes in mind will structure the theory. Secondly, an understanding of basic causes of stunting is useful when aiming to separate the immediate effects of a border war from other structural causes of stunting that will be treated as exogenously given.

2.2 How conflict may affect stunting

Taking the conceptual framework as a starting point, precise hypotheses are needed on the mechanisms through which conflict is likely to have affected the underlying causes of growth stunting, and which children are likely to have been victims. A useful distinction made by Bozzoli and Bruck (2009) is between households within a conflict zone, and households that are idiosyncratically affected. Food security is a major concern on the Horn of Africa, and a number of hypotheses on how food security has been affected by the border war have been adopted by White (2005) from studies of the 1974-1991 independence war.

One hypothesised effect is that the absence of men of productive age in production due to conscription, deaths and disabilities pose a threat to household food security caused by the border war. Mandatory conscription into the military service was extended beyond the previously stipulated 18 months because of the border war to become open-ended, also after the end of the war (Kibreab, 2009). Whereas Gilkes (2004) claims that removing so many able-bodied individuals from agriculture intensified an already serious food situation, White (2005) claims that 'the economic loss to their households was mitigated to some extent by remittances of military pay'. A direct effect of conscription on child stunting should affect all children living in households with conscripted members, regardless of whether the children experienced the war or live within the conflict zone. A more macroeconomic effect on food security of large-scale conscription might be plausible, although the national service especially since 2002 has also been engaged in development projects, yet such analysis lies beyond the realm of the thesis.

A second effect stems from internal displacement, peaking in 2000 with 1.1 million displaced persons in Eritrea (Norwegian Refugee Council and Global IDP Project, 2004). These were placed both with family members and in camps, and were potentially subjected to a higher risk of food insecurity both during the journey, when displaced and possibly as well upon return. Most families had returned to their place of origin by 2002, and the DHS survey does not include data on temporary displacement. The effect on stunting for returned IDPs will be captured by children who experienced the conflict and were living in the conflict zone in 2002. In addition, one should expect an effect on all children in households where a woman is still displaced as of 2002 or households that were hosting IDPs at that time. A distinct group are the 75.000 deportees popularly referred to as *Amiche*, as all Eritreans and Ethiopians of Eritrean descent living in Ethiopia were expelled during the war (Riggan, 2011). These were generally skilled and relatively well off business owners in Addis Abeba, and are not likely to be growth stunted.

Partly connected to the IDP situation is the loss of access to arable land and pastures that many experienced during the border war. Destruction and land mines are other contributors to reduced food production during and after the conflict. Pastoralists in the conflict zone are likely to be particularly affected as they need larger areas of land for their cattle, and were dependent upon movement across the border to maintain their livestock (Moehler, 2007).

Before the border war, Ethiopia was by far the most important trading partner for Eritrea in terms of exports (Stryan, 2004). As documented in table 1, the disruption became complete during the war, first as a reaction to Eritrea's introduction of their own currency in 1997. The shortfall in trade with Ethiopia is particularly likely to affect those households that were dependent upon trade with Ethiopia for food and livelihoods, typically along the trade route between the two capitals. Furthermore, reduced access to markets within Eritrea as a result of the conflict is likely to have contributed to increased food insecurity in the conflict zone. Adding to problems of accessing food for non-producers was an inadequate international response to the food crisis, according to White (2005) due to the lack of a clear separation between the principled conditionality put on development aid to the two countries at the time, and humanitarian assistance. However, food aid from international donors rapidly accelerated after media attention in March 2000.

Table 1: Composition of imports and exports in million Nakfa, 1995 and 1997-2002

	1995	1997	1998	1999	2000	2001	2002
Imports							
Food	427	600	460	748	1126	1677	1439
Of which Ethiopia	91 (21 %)	203 (34 %)	19 (4 %)	0	0	0	0
Total Imports	2536	3062	2693	3129	3344	4356	5447
Of which Ethiopia	146 (6 %)	275 (0.9 %)	25 (1 %)	0	0	0	0
Exports							
Food	141	81	58	68	110	90	423
Of which Ethiopia	57 (40 %)	15 (19 %)	3 (5 %)	0	0	0	0
Total Exports	529	375	197	164	189	193	578
Of which Ethiopia	354 (67 %)	238 (64 %)	197 (27 %)	0	0	0	0

Sources: International Monetary Fund (2000, 2003)

A fifth possible channel is the diversion of resources due to the war effort. The defense spending exceeded 1/3 of the GDP during the conflict (see table 2). It has not dropped to pre-war levels during peacetime, as there has not been any large-scale demobilisation, and much military equipment had to be replaced due to destruction in the war's final phase (Stryan, 2004). The immediate consequences for food security apart from fewer agricultural workers are probably a haltering of development towards improved and less rain-dependent agriculture and the construction of infrastructure that could increase access to markets.

Table 2: GDP growth and spending as percent of GDP, 1997-2002

	1997	1998	1999	2000	2001	2002
Real GDP Growth (% change)	7.9	1.8	0.0	–13.1	10.2	1.8
Defence spending	12.7	35.0	37.2	35.8	24.2	23.3
Education and health spending	4.4	4.7	4.6	4.2	3.6	3.3

Source: (International Monetary Fund, 2003)

The effect on health services and health environment may be hypothesised to follow broadly similar channels (see Iqbal (2010)). Physical destruction may limit access to health services and drinking water. Large population movements in emergency situations often contribute to the spread of communicable diseases, and exposure to diseases that the children lack immune systems to handle. Restrictions on market access and inadequate humanitarian response may hinder the movement of medicine and medical aid. And finally, less spending on health may have immediate effects through inferior health care or reduced immunization rates.

The third underlying cause, maternal and child care, is somewhat different. In the long term, female empowerment may be strengthened as a consequence of conflict. Women's contribution to the independence war both as soldiers, fund-raisers and labourers on equal terms as men created new perceptions of the roles and rights of women in Eritrea (Woldemicael, 2010). Feminism as an ideology furthermore played a role in creating a common Eritrean identity not based on segregated traditional values, which was important for the popularisation of the independence struggle in such a religiously and ethnically diverse country (Bernal, 2006). However, norms should be treated as a more slowly progressing factor, and any immediate effect of conflict thus seems less plausible. Fewer resources devoted to education resulting in less educated women might furthermore offset positive effects in a longer-term perspective. One more immediate effect of conflict on maternal and child care may, however, be hypothesised through the effect of absent males. Widows and possibly as well wives of mobilised men are likely to have strengthened their position within the household. Working women may also have more of a say on e.g. financial issues that can benefit the child, yet may also have less time for childcare and feeding. Woldemicael (2010) also speculates that there might be a more immediate negative effect on the role of women in decision-making and women's access to resources due to the diversion of resources to the military and economic crisis. Table 3 summarises the hypothesised channels at work.

Table 3: Hypothesised immediate effects of conflict on stunting

	Food security	Health	Maternal and child care
Absence of males	–		+ / –
Displacement	–	–	
Physical destruction	–	–	
Access to markets and assistance	–	–	
Diversion of resources	–	–	–

2.3 Conflict and household coping strategies

According to Townsend (1994), households under distress may adopt a number of mitigation strategies, including diversification of income-generating activities, sales of assets and borrowing and receiving gifts or transfers from social networks. A particularly likely adaptation in income-generating activities due to the war in Eritrea is the replacement of working aged men with women, children and elderly as labour force. Women may have increased their labour participation as a result of loss of males, mobilisation of males for military service, other conflict-induced reductions in income and lower fertility due to absence of males. Other relevant alterations in income-generating activities may be reactions to losses in market access, where production of food crops for own consumption is a plausible response. Among urban households, the 1996/1997 Eritrean Household Income and Expenditure Survey shows that more than half of all household income came from remittances from abroad (Arneberg and Pedersen, 2001). Although providing an important source of income during the war, such data is unfortunately not available in the DHS survey.

An interesting aspect to consider is whether stunting to some extent has been mitigated by mutual insurance systems, and in particular whether community assistance has also mitigated conflict-induced stunting. Habtom and Ruys (2007) find that informal networks, organised along community, religious or kinship groups, are important in providing for health care and social costs in Eritrea. Two aspects are interesting to study in this respect. First, to what extent has stunting been avoided in Eritrea due to community assistance? Secondly, what sustains or challenges these mutual insurance systems, and how well have the mutual insurance systems functioned during conflict? To better understand possible mechanisms at work, I will here introduce a model for mutual insurance from Ray (1998, p. 605-610).

2.3.1 A mutual insurance model

Debraj Ray's model seeks to explain why mutual insurance arrangements may be difficult to enforce in many settings, and what strengthens and weakens a mutual insurance system. The type of mutual insurance system that we study is an informal arrangement which is not codified in a legally binding contract, which is typically the case in low-income communities. Another feature which is also commonly observed is that the same families take turns being a receiver and a provider of assistance to others (Coate and Ravallion, 1993).

I start with considering a setting with a community with many households, where each household is subject to idiosyncratic risk. They may produce two outputs, high (H) or low (L), and there is a probability p that the high output is produced. With perfect insurance, the amount each household gets is $pH + (1 - p)L = M$. The utility function is equal for all households and has increasing and diminishing returns to income, $u'(\cdot) > 0$ and $u''(\cdot) < 0$. This implies that the households are risk averse and that $pu(H) + (1 - p)u(L) < u(M)$, meaning that all are better off with an insurance scheme if it can be enforced. In a particular period, the gains for a household from deviating from the insurance scheme if producing high output is defined by the gain function:

$$\mathbb{G} = u(H) - u(M) \tag{1}$$

In addition, the household also expects losses from deviating from the insurance scheme. The model assumes that the household will be expelled from the insurance scheme if deviating, and there may also be social sanctions or social gains from participating which will be lost. The loss function L is specified as:

$$\mathbb{L} = N\{u(M) - [pu(H) + (1 - p)u(L)]\} + S \tag{2}$$

Where N is the number of periods that the household thinks ahead, and S represents the social sanctions. For the insurance scheme to be viable, we need $\mathbb{L} \geq \mathbb{G}$, and the enforcement constraint then becomes:

$$N\{u(M) - [pu(H) + (1 - p)u(L)]\} + S \geq u(H) - u(M) \tag{3}$$

If the enforcement constraint in equation (3) does not hold, perfect insurance is not viable. Yet, there may still be room for partial insurance as a second-best strategy for the households. We denote the consumption or net income after insurance payments of a high-output producing household X, and the consumption or income including assistance from the insurance scheme of a low-output producing household Y. As we need the insurance budget to balance, the following equation must hold:

$$pX + (1-p)Y = pH + (1-p)L = M \tag{4}$$

The enforcement constraint then becomes

$$N\{[pu(X) + (1-p)u(Y)] - [pu(H) + (1-p)u(L)]\} + S \geq u(H) - u(X) \tag{5}$$

The second-best insurance scheme is the solution which minimises $X - Y$ given the enforcement constraint. The solution will depend positively on N and S. This has some important implications for our conflict analysis. An interesting difference between a conflict situation and other negative shocks is that the availability of traditional coping strategies is more likely to be altered. Collier (1999) and others point to the disruption of social order as an important channel to study. The time horizon during normal shocks may be one of several generations, as populations cohabit the same area across decades. Conflict may disrupt such patterns due to displacement and uncertainty about whether and to what households will return. This would also have consequences for the social sanctions that a community is able to impose.

An extension to the model is to consider the case when communities are faced with a common rather than an idiosyncratic shock. This has been modelled by Coate and Ravallion (1993); my extension of Ray (1998) will be simpler, yet carry the same implications. I define an unexpected common shock to the community $\theta < L$, with output $M - \theta = p(H - \theta) + (1-p)(L - \theta)$. The households do not expect the shock to re-occur, hence as before, $E(M) = M$. The gain function from equation (1) now becomes:

$$\mathbb{G} = u(H - \theta) - u(M - \theta) \tag{6}$$

Whereas the loss function remains the same as in equation (2) as there are no changes in expected output. The effect on the gains can be calculated as:

$$\frac{\delta \mathbb{G}}{\delta \theta} = -u'(H-\theta) + u'(M-\theta) > 0 \quad (7)$$

We see that the gain function is increasing in θ, due to the diminishing marginal utility. The shock thus weakens the insurance scheme, as the relatively well-performing will have a larger incentive to deviate during an aggregate shock of this type. If conflict was regarded as an extra-ordinary rather than a re-occurring event, such a shock is likely to have challenged mutual insurance systems. In addition, this could also have bearing on social sanctions if systems were not in place for determining fair contributions in this extra-ordinary case.

An ideal empirical test of this model would be similar to that of Townsend (1994). He used ICRISAT data on consumption and income of households in three villages across time, and tested whether the consumption for each household varied with its own income or with the average income of the other households in the village. The DHS survey does not provide such data. However, as when studying the effect of conflict on stunting, we may use the time of birth as a pseudo-panel, and stunting as an indicator of whether the households have managed to uphold a desired minimum level of emergency consumption. Without mutual insurance, my assumption is that the probability of stunting will depend on household wealth, which is observed at the time of interview in 2002. The level of household wealth reflects the household's opportunities for self-insurance, as well as being a proxy for household income. The level of wealth of a household should thus be a stronger indicator for children who have experienced conflict in a conflict-affected area than for children outside the area. I will furthermore calculate the average wealth in the community excluding the household. It can be interpreted as the benefit of having a wealthy neighbour. If there is a benefit from this variable for children in the sample, we may conclude that some level of mutual insurance is at work. We would also expect the effect of average wealth to be smaller among the conflict-affected children. A third indicator that will be applied is the standard deviation of the household wealth in the cluster, which I will use as a measure of inequality. Social sanctions in the model may be regarded as an expression of social cohesion, which is affected by inequality. We would thus expect children in mutually insured communities to benefit from equality, as it strengthens the insurance scheme.

2.3.2 Fertility as a coping strategy

A final coping strategy that might have been employed is that of adjusting fertility levels in response to conflict. Following the framework of Easterlin and Crimmins (1985), there is a need to distinguish between the 'supply' side of fertility where fewer births are a result of reduced frequency of intercourse or malnutrition among women, and changes in fertility preferences which are conscious and deliberate adjustments to conflict. The direction of fertility adjustments due to war may go both ways, as couples may have more children due to a larger need for children as insurance, or may postpone or reduce the number of births due to short-term costs or desires for maintaining a certain level of welfare for each child. An excellent analysis of the impacts of war, famine and economic decline on fertility in Ethiopia during the Derg regime from 1972-1988 is provided by Lindstrom and Berhanu (1999). They find that all types of crises reduced annual fertility, yet whereas fertility rebounded in the 1970s in relatively better years, the crises led to permanent rather than temporary reductions in fertility during the 1980s. Reasons for a permanent rather than temporary decline in the 1980s were the severity in the combination of war, famine and economic decline, that the situation appeared to be more prolonged in nature, and that couples during crises became aware of opportunity costs of children and removed hesitations towards fertility reduction and modern contraceptives. Whether some of the sharp fertility decline seen in Eritrea from 1995 to 2002 was part of a conflict adjustment and whether the change is a temporary postponement of births or a permanent decline will be analysed using both actual birth histories and data on fertility preferences.

3 An exploration of previous study

A working paper by Akresh, Lucchetti, and Thirumurthy (2010) examines the effects of the Eritrean-Ethiopian border war on height-for-age Z-scores of children under five in Ethiopia and Eritrea. It uses three different specifications to capture the effect of conflict in differences-in-differences analyses. Differences-in-differences analyses observe two groups, a treated and a non-treated group, at two periods of time, before and after treatment (Angrist and Pischke, 2009). In this case, children born after the war are equivalent to the before-treatment category, whereas those born before or during the war can be regarded as after treatment. The treatment itself is being in the conflict zone or not. By observing the difference between the height-for-age of children who have experienced the war and lived in the conflict zone and the counter-factual estimation of how tall they would have been if they had followed the same trend as those not living in the zone, one derives a treatment effect, which is the causal effect of conflict. In one regression, the three Eritrean regions that experienced war (Gash-Barka, Debub / Southern and Debubawi Keyih Bahri / Southern Red Sea) are considered as the conflict zone. In a second regression, they consider whether the household is located within 75 kilometers of one of three conflict hot-spots. The three hot-spots are Badme in the west, Tsorona / Zalambessa in the centre, and Bure to the east, all along the Eritrean-Ethiopian border. Table 4 shows coordinates and total number of fatalities of these places, found using the ACLED database and Google Maps. I use these coordinates together with GPS data from the DHS survey for an estimation of aerial distance to closest conflict hot-spot using ArcGIS.

Table 4: Coordinates and sum of ACLED fatalities in three war sites

Location	Latitude	Longitude	Fatalities
Badme	14.7275	37.80306	2723
Tsorona-Zalambessa	14.657	39.264	1512
Bure	12.6	42.6667	785

This chapter will first provide a reproduction of these analyses conducted by Akresh, Lucchetti, and Thirumurthy (2010). Thereafter, I will raise a number of critiques to their approach. I find that given their specifications, their result is not robust when the distance to the hot-spots is varied. I will then discuss three threats to internal validity that may have caused the problem. Of less importance is that by using data on children whose mothers were available for interview rather than the data found in the household survey, there is a selection bias in their data. Secondly, I argue that two cases of imperfect multicollinearity cause imprecise estimators, and that better controls are available. As important is that the theoretical foundation for their model does not justify the use of Z-scores rather than stunting as dependent variable, and furthermore that their model therefore is quite sensitive to problems of age misreporting in the dataset.

3.1 A replication

The model estimated by Akresh, Lucchetti, and Thirumurthy (2010) can be simplified to the following two equations:

$$\begin{aligned} HAZ_{ijt} = \alpha_j + \delta_t + \beta_1(War\,Region_j * Born\,During\,War_t) \\ + \beta_2(War\,Region_j * Born\,Before\,War_t) + \epsilon_{ijt} \end{aligned} \quad (8)$$

$$\begin{aligned} HAZ_{ijt} = \alpha_j + \delta_t + \beta_1(Close\,To\,War\,Site_j * born\,during\,war_t) \\ + \beta_2(Close\,To\,War\,Site_j * born\,before\,war_t) \\ + \beta_3(Close\,To\,War\,Site_j) + \epsilon_{ijt} \end{aligned} \quad (9)$$

Where HAZ_{ijt} is the height-for-age Z-score of child i, born in cluster j at time t. *Born During War* is 1 if a child is born between May 1998 and December 2000, and *Born Before War* is 1 if a child is born between March 1997 and April 1998. The following controls are exercised:

- A control for gender is included, as we expect boys to be shorter than girls (Wamani, Astrom, Peterson, Tumwine, and Tylleskar, 2007).
- The authors control for age of the child through year of birth fixed effects.
- The authors control for other, confounding factors through a region-fixed effect.
- In one specification, the authors also control for region-specific time trends.

The three different regressions that are replicated are the hot-spot analysis with and without region-specific time trends, and the war region regression without region-specific time trends. The analysis with war regions and region-specific time trend will not be conducted as there is a perfect multicollinearity problem because being born in the war region before the war is equal to being born in one of three regions in 2001 or 2002. Results from the replication are shown in table 5. Slightly smaller yet very similar results are found in regression (2) and (3), but not in regression (1) where the authors found a much larger and significant effect.

Table 5: The impact of war exposure on children's height-for-age Z-score: A replication

OLS, Height-for-age Z-score	(1)	(2)	(3)
War Region * Born During War	–0.100		
	(0.087)		
War Region * Born Before War	0.114		
	(0.101)		
Close to War Site * Born During War		–0.220**	–0.332***
		(0.089)	(0.128)
Close to War Site * Born Before War		0.091	–0.020
		(0.101)	(0.141)
Close to War Site		0.201	0.274**
		(0.109)	(0.128)
Gender Control	Yes	Yes	Yes
Child Age Fixed Effects	Yes	Yes	Yes
Region Fixed Effects	Yes	Yes	Yes
Region-Specific Time Trends	No	No	Yes
Observations	5341	5341	5341
Adjusted R^2	0.1830	0.1842	0.1840

Robust and clustered standard errors in brackets. * significant at 10 %, ** significant at 5 %, *** signficant at 1 %.

3.2 Critiques

A first question as to robustness of the results is whether the distance of 75 km from a conflict hot-spot is a plausible distance for conflict to affect children, and whether the analysis holds if the distance is varied. According to the authors, 75 km is used as a cut-off point because it is the average distance between the clusters and the hot-spots in Eritrea. They also find quantitatively similar results using 100 km and 125 km. Finally, they use a continuous measure of distance, and claim that 'results are consistent as children born during the war and living closer to a conflict site have significantly lower height-for-age Z-scores'

(Akresh, Lucchetti, and Thirumurthy, 2010). With a continuous measure, I did not find significant results in the three cases without regional trends, with regional trends and with region-specific time trends. However, the signs of the coefficients point in the right direction.

A more intuitive approach to setting a cut-off point would be to consider the likely movement of people and goods. If being near a conflict point has limited access to markets or assistance, that would affect child growth. Secondly, we may assume that being near a conflict point increases the probability that the household has been displaced during the war. A similar causal link can be drawn in the case where it has directly caused destruction or death to the household. For the last hypothesis, a quite narrow distance should be used. For access to markets, it is important to remember that the most common means of transportation in Eritrea are donkeys, camels, bicycles or on foot, and that the topography puts further restrictions on movements. Whereas 50 km might be reachable in a day by non-fueled transportation, 75 km would require overnight stay. It is thus reasonable to expect that the effect of conflict within a 50 km radius from the conflict hot-spot should be larger, although the statistical strength of the relationship might be lower due to fewer observations.

Table 6: The impact of war exposure within 50 km on children's height-for-age Z-score

Height-for-age z-score	(4)	(5)
Within 50 km of War Site * Born During War	–0.105	–0.105
	(0.101)	(0.124)
Within 50 km of War Site* Born Before War	0.070	–0.010
	(0.127)	(0.143)
Within 50 km of War Site	0.108	0.119
	(0.114)	(0.122)
Gender Control	Yes	Yes
Child Age Fixed Effects	Yes	Yes
Region Fixed Effects	Yes	Yes
Region-Specific Time Trends	No	Yes
Observations	5341	5341
Adjusted R^2	0.1824	0.1821

Robust and clustered standard errors in brackets. * significant at 10 %, ** significant at 5 %, *** signficant at 1 %.

Table 6 shows results using 50 km as distance to war site. The effect of conflict on child growth using a shorter distance reduces the effect of being born during war to a half and a third of the size of regressions (2) and (3) respectively, and is now insignificant. Most of the effect of conflict on growth found by the authors thus seems to be driven by children living in between 50 km and 75 km from a war site. This may be evidence of either a lack of effect of spacial closeness to the three war sites on child growth, or that the regression is mis-specified. I will in the following discuss a number of short-comings of the authors' approach, and chapter four proves that these short-comings are the reasons why the results are not robust when shortening the distance.

3.2.1 Selection bias

The Demographic and Health Survey consists of two questionnaires: One household questionnaire where all children under five are measured, and one women's questionnaire, where the children under five of women aged 15-49 who answered the questionnaire are measured. In some cases, the mother is absent due to death or residence elsewhere, or she is not eligible for interview, because she is temporarily away, ill, or simply refuses. The household questionnaire contains 5612 children whereas the women's questionnaire used by the authors contains 5341 children. As there are reasons to believe that the children who do not have mothers responding to the questionnaire are systematically different, this is a potential source of selection bias. However, using the smaller sample has not produced any significant problems for the regression results.

3.2.2 Imperfect multicollinearity

Imperfect multicollinearity is characterised by one regressor being highly correlated with other regressors (Stock and Watson, 2011). Two regressors cause problems in this case, and there are better substitutes that can be used. One is the year of birth of the child, used to control for age. Children born after the war are the only children born in 2001 and 2002. It is thus not possible to decide whether these children deviate less from the standard because younger children tend to do so as argued in chapter 2, or because they were not affected by the war. Furthermore, there are good reasons to believe that the effect of age is very different for different children born in the same year, and that age is therefore not fully controlled for. For instance, a child who is 5 months old at the time of the interview should have an equal probability of deviating from the standard, regardless of whether the interview was conducted in March or July. The age in months at time of interview is what our theory in chapter 2 stipulates will affect the height of children, not the calendar year of birth.

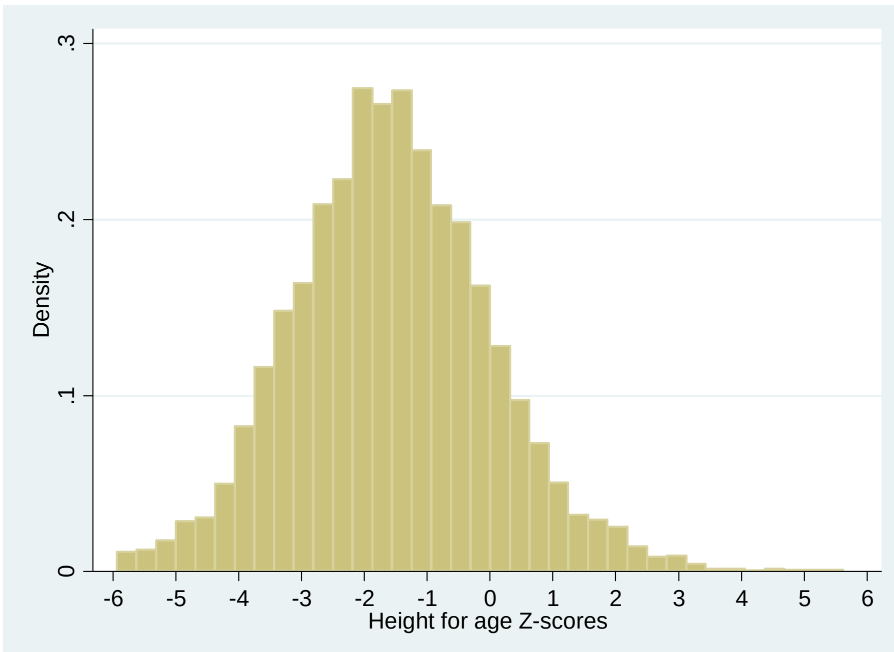
The second problem of imperfect multicollinearity is across space. There is a strong correlation between administrative region, which is the control used by the authors, and conflict zone. Especially when adding the region-specific time trend, parts of the conflict effect might be captured there rather than in the treatment effect. As worrisome is my opinion that administrative region does not control for the confounding factors that we would want. An ideal control should take care of any factors that affect growth but has not been changed due to conflict. For instance, if households in the conflict zone were poorer prior to the conflict, that would cause the older children in the conflict zone to be shorter than their peers outside the conflict zone even if their younger siblings are of equal height, as the effect of malnutrition on growth accumulates with age. Also if genetic differences in this ethnically diverse country would cause differences in height, the younger ones would be more similar.

3.2.3 Accuracy of the dependent variable

Keeping in mind the mentioned issues of concern for internal validity, the question of validity should also be seen as a more fundamental issue of whether the statistical inferences about causal effects are valid. Do we have a sound model for how conflict affects child growth? A necessary condition for causal inferences is a solid theory for how the independent variables affect the dependent variable. With a closer look at the dependent variable and the theory of growth retardation, our theory is that conflict may reduce food availability or alter the health environment in ways that make children shorter than healthy children. Our theory does not, however, predict why some children in the sample are taller while others are slightly shorter than healthy children of the same age. For our regression to be valid, a closer examination is thus needed of our dependent variable.

The distribution of height-for-age Z-scores in Eritrea according to the NCHS standard is shown in figure 3. The Z-score has a mean value of –1.56, with a standard deviation of 1.57. Of these children, 39.6 % are considered stunted, as their height-for-age Z-score is below the mean minus two standard deviations of the healthy population. The WHO Child Growth Standard revealed slightly higher numbers, with a mean of –1.72, a standard deviation of 1.68 and 45.4 % stunted. The standard deviation of the Z-score can be used as a measure of data quality, and the dataset displays a standard deviation around average for

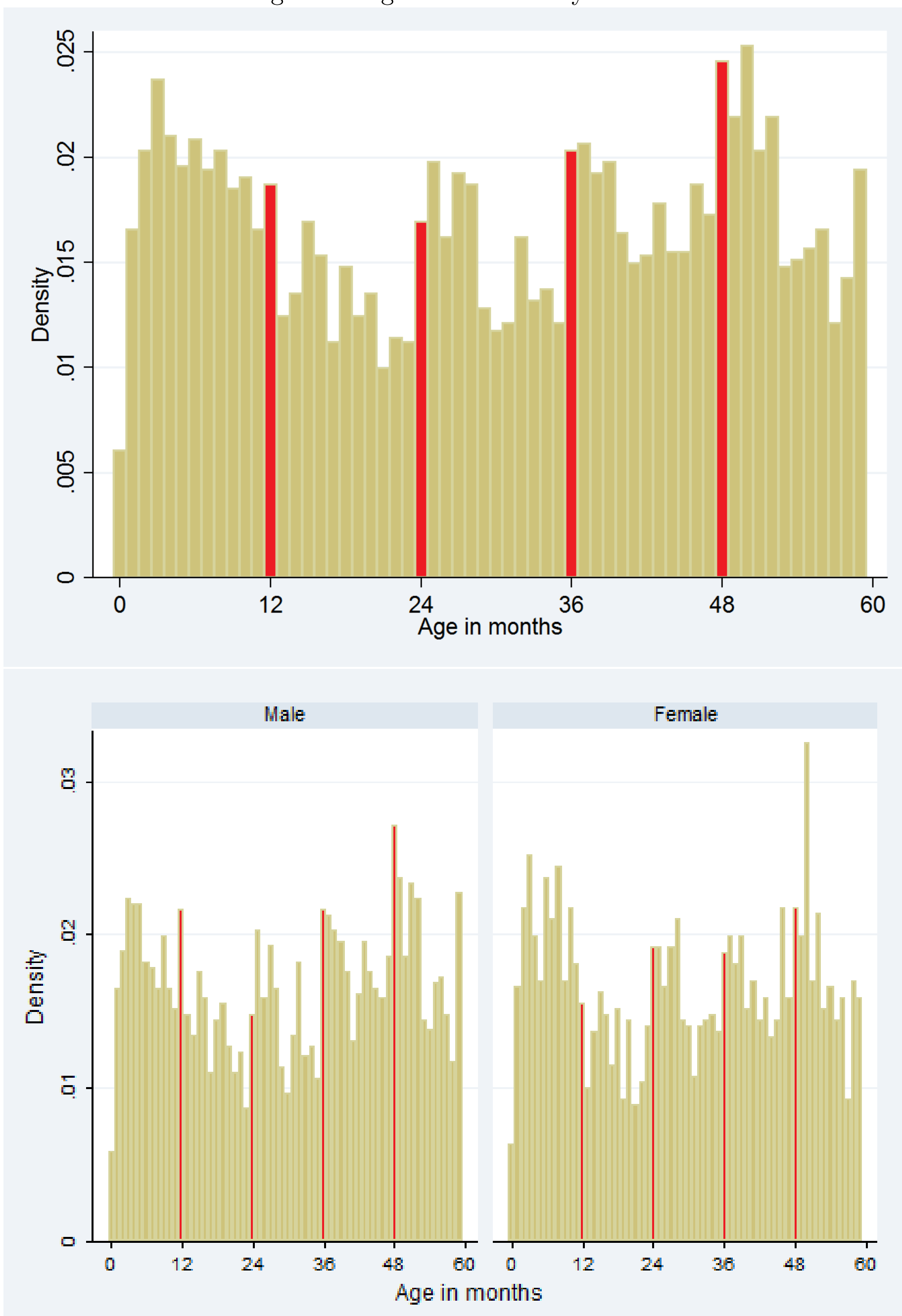
Figure 3: Distribution of height-for-age Z-scores



DHS surveys (Mei and Grummer-Strawn, 2007). The relatively high standard deviation compared to the healthy population furthermore means that many observations are found far from the mean, and hence that much of the variation is among children who do not display an unhealthy growth level. Only in the cases where a child is stunted does theory support that the children are subjected to growth retardation caused by malnutrition, an unhealthy environment or inadequate child care. Most of the variation used in a regression with the Z-score as dependent variable would thus be unrelated to conflict and the underlying causes of growth retardation.

An additional problem with using height-for-age Z-scores as dependent variable is that it is very sensitive to misreporting on age, and the dataset is known to have problems of age heaping and inaccurate age reporting (National Statistics Office of Eritrea and ORC Macro, 2003). Figure 4 shows the distribution of children by age in months at the time of interview, in total and by sex. The likely ages of heaping are 12, 24, 36 and 48, and these are marked in red. There seems to be a problem of age heaping on 24, 36 and 48 months, and among boys also on 12 months, which is problematic as the effect of heaping on Z-scores is larger for younger children under three years. The reasons for age heaping could be uncertainty about the actual age of the child and / or a tendency to report the age that the child looks like in terms of height and weight. Oshaug, Pedersen, Diarra, Bendech, and Hatløy (1994) demonstrate that this has very serious consequences for anthropometric measures. They also find that using the percent stunted rather than Z-scores does not solve the problem. However, the binomial measure is only affected by heaping which leads to a change that mis-categorises a child, whereas the the Z-score is incorrect for all children that are reported with an incorrect age.

Figure 4: Age distribution by month



4 The effect of conflict on stunting in Eritrea

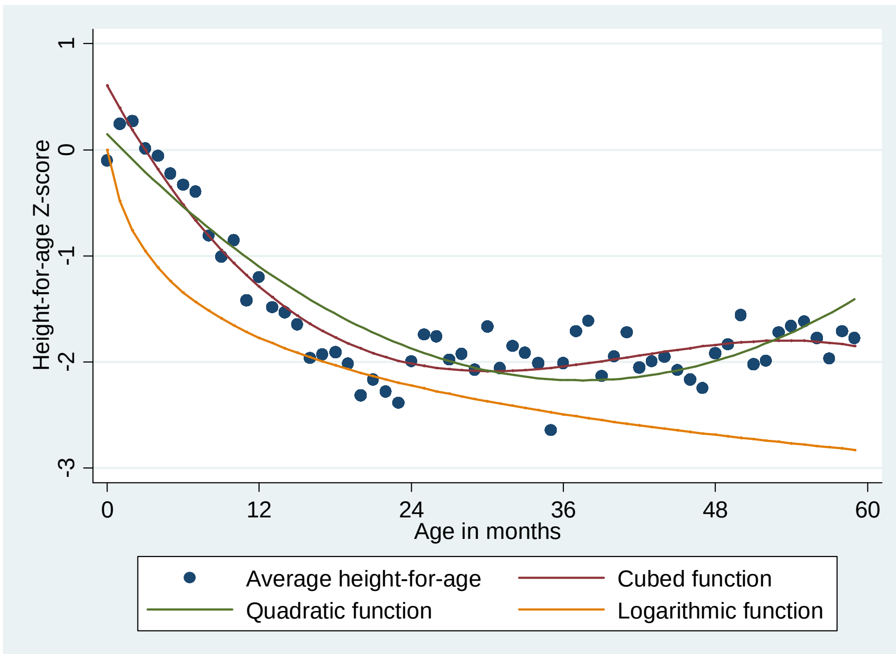
My analysis of the conflict-stunting relationship will make three main improvements on the previous study:

1. The mentioned threats to validity (selection, multicollinearities and inaccuracy of dependent variable) will be improved upon;
2. alternative measures of being located within the conflict zone will be attempted; and
3. the analysis will take into account effects of conflict on stunting that do not rely on geographic closeness to conflict sites.

4.1 An improved model

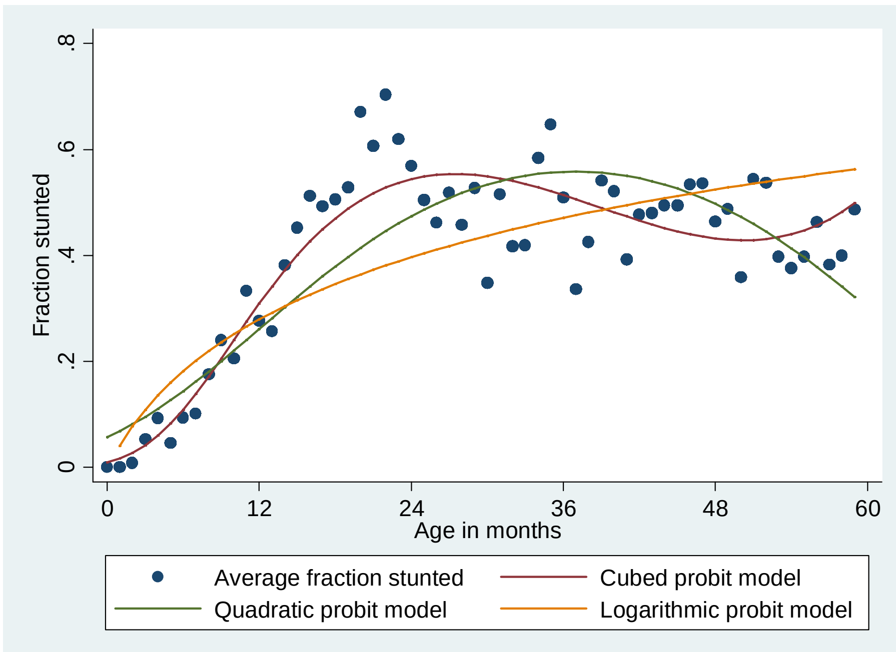
A major improvement on the Akresh, Lucchetti, and Thirumurthy (2010) study is to use more accurate controls for age and other confounding variables. Theory and empirical evidence from Africa as shown in figure 1 on page 5 suggests that height-for-age follows a linear reduction until 24 months, and then a horizontal trend with quite some variation. This can be much better approximated with a continuous specification than with jumps for each calendar year. By properly controlling for age, we can get around the multicollinearity problem and get more accurate results. Figure 5 shows the average height-for-age Z-score of children by age in months. It suggests that a cubic regression form is a quite good fit. Regressions furthermore show that the cubed age term is significant when added, whereas age to the fourth is not. It also passes the test for U-shaped relationship by Lind and Mehlum (2010).

Figure 5: Height-for-age Z-scores by age in months



As I will be using a probit model with being stunted as the dependent variable, a similar experimentation with different functional forms was carried out on the fraction stunted by age in months. Figure 6 shows plots of probit models with quadratic, cubed and logarithmic age functions. As in figure 5, the quadratic model has a maximum around 37 months which seems too high according to the empirical evidence. It also in this case shows a too flat trend for the young children, and a sharp fall after 37 months which our theory does not explain. The cubic specification is again a better fit, and the cubed age term is significant.

Figure 6: Fraction stunted by age in months



Following the WHO recommendation, parental height is a strong determinant of child height, and provides an excellent control as it is certainly unaffected by the conflict. A control for maternal height as well as an interaction between maternal height and the time trend is therefore to be preferred in place of the administrative region. Where maternal height is missing, average height of reproductive women in the household or cluster could be used along with a dummy to capture systematic differences for this group.

Other improvements are to use the full dataset and having the probability of being stunted rather than height-for-age Z-scores as dependent variable.

The following probit regression will be attempted:

$$\begin{aligned} Stunted_{ijt} = \alpha_j &+ \beta_1(Close\,to\,War\,Site_j * Born\,During\,War_t) \\ &+ \beta_2(Close\,to\,War\,Site_j * Born\,Before\,War_t) \\ &+ \beta_3 Close\,to\,War\,Site_j + \beta_4 X_{it} + \epsilon_{ijt} \end{aligned} \quad (10)$$

Where *Close to War Site* is 1 if the cluster is within 50 km and 75 km of one of the three conflict hot-spots and X consists of the following control variables:

$$\begin{aligned} X_{it} = {} & \gamma_1 Female_i + \gamma_2 Time\,Trend_t + \gamma_3 Mother\,Height_i \\ & + \gamma_4 No\,Data\,on\,Mothers_i + \gamma_5 Mother\,Height_i * Time\,Trend_t \\ & + \gamma_6 No\,Data\,on\,Mothers_i * Time\,Trend_t \end{aligned} \quad (11)$$

And the time trend is cubic:

$$Time\,Trend_t = \delta_1 Age\,in\,Months_t + \delta_2 (Age\,in\,Months_t)^2 + \delta_3 (Age\,in\,Months_t)^3$$

Table 7: The impact of closeness to war site on the probability of being stunted

Probit, dependent variable: Stunted	(6)	(7)
Within 75 km of War Site * Born During War	0.227**	
	(0.102)	
Within 75 km of War Site * Born Before War	0.090	
	(0.118)	
Within 75 km of War Site	–0.104	
	(0.102)	
Within 50 km of War Site * Born During War		0.308**
		(0.133)
Within 50 km of War Site * Born Before War		0.163
		(0.158)
Within 50 km of War Site		–0.201
		(0.138)
Female	–0.046	–0.047
Age in Months	0.853**	0.835**
Age^2	–0.023*	–0.023*
Age^3	0.0002	0.0002
Mother Height	–0.005	–0.005
No Data on Mothers	–0.145	–0.151
Mother Height*Age	–0.004*	–0.004*
Mother Height*Age^2	0.0001	0.0001
Mother Height*Age^3	$–8.70*10^{-7}$	$–8.36*10^{-7}$
No Data on Mothers*Age	–0.025	–0.023
No Data on Mothers*Age^2	0.0008	0.0008
No Data on Mothers*Age^3	$–7.46*10^{-6}$	$–6.92*10^{-6}$
Constant	–1.585	–1.454
Observations	5612	5612
Pseudo R-squared	0.1253	0.1253

Robust and clustered standard errors in brackets. * significant at 10 %, ** significant at 5 %, *** signficant at 1 %.

The results are shown in table 7. Notice first that the effect of being born during the war within 50 km now is estimated to be greater than the effect of being born during the war within 75 km, which was not the case in my replication study. For interpretation, we calculate the difference between being born during the conflict in the conflict zone with the counter-factual case of being born in the conflict zone had the conflict not occurred. The probit model is based on the cumulative standard normal distribution and is non-linear, and one therefore needs to take into account that the size of the effect depends upon the level of the dependent variable (Stock and Watson, 2011). The average treatment effect is the difference between the probability of being stunted given that the child is born in the conflict zone during the war and the probability of being stunted if born in the conflict zone after the war, with other variables set to average levels of children born during war in both cases. A single coefficient, $\hat{\beta}_1$, thus captures the treatment effect. It can be calculated as:

$$\begin{aligned} &Treatment\,Effect = \\ &\quad Pr(Stunting\,|\,Born\,During\,War = 1 \cap Close\,to\,War\,Site = 1 \cap X = \tilde{\mathbf{x}}) \\ &\qquad - Pr(Stunting\,|\,Born\,After\,War \cap Close\,to\,War\,Site = 1 \cap X = \tilde{\mathbf{x}}) \end{aligned}$$

$$\tilde{\mathbf{x}} = E(X|Born\,During\,War = 1)$$

$$Treatment\,Effect = \Phi(\hat{\alpha}_j + \hat{\beta}_1 + \hat{\beta}_3 + \hat{\beta}_4\tilde{\mathbf{x}}) - \Phi(\hat{\alpha}_j + \hat{\beta}_3 + \hat{\beta}_4\tilde{\mathbf{x}})$$

Where Φ is the cumulative standard normal distribution function and $\tilde{\mathbf{x}}$ are the averages of the controls for children born during the war. With the 50 km cut-off, the treatment effect can be calculated as:

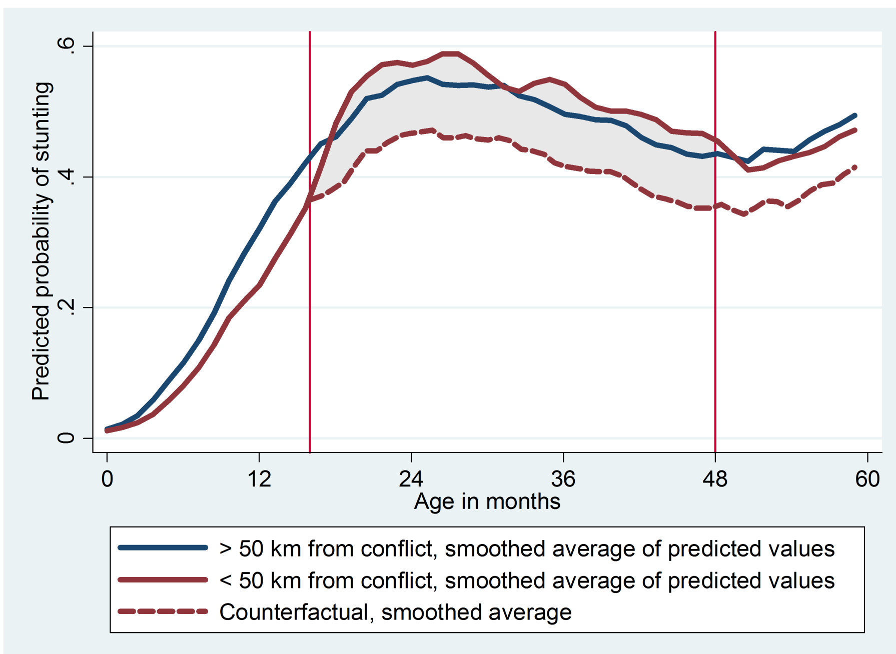
$$\Phi(-1.454 + 0.308 - 0.201 + 1.510) - \Phi(-1.454 - 0.201 + 1.510)$$

$$= \Phi(0.163) - \Phi(-0.145) = 0.565 - 0.442 = 0.122$$

The exposure to conflict has in this case increased the probability of being stunted by 12.2 %, from a probability of 44.2 % had there not been a conflict to a probability of 56.5 %. The probability of being stunted has increased by a factor of slightly more than a quarter due to the war, and one in five war-exposed and stunted children is stunted because of the conflict. This points to a significant worsening of the food and health situation of children in Eritrea due to the war. However, the generally unfavourable situation for children in Eritrea is the main factor causing stunting, also within the conflict zone.

As all children born before and during the conflict have experienced the war, one could also expect children born before the war to display a significant treatment effect. However, recall from chapter 2 that stunting above two to three years of age is more a state than a continuing process, caused by the cumulative effect of malnutrition on stunting during the first two years. Children in this group were up to one year old at the onset of conflict, and are expected to have grown unaffected by conflict until May 1998. In addition, their mothers did not experience conflict during pregnancy, which for the younger children might have led to lower birth weights which affects later growth. The effect of conflict on children born before the war should thus lie in between those born during and those born after the war, which turns out to hold in the regressions.

Figure 7: Illustration of treatment effect



The differences-in-differences analysis may also be illustrated graphically. In figure 7, local polynomial smoothed lines are drawn between predicted values from the regression, averaged by age in months. Vertical lines indicate the median age in months for children born in December 2000 and May 1998, which are 16 and 48 respectively. The counter-factual line is drawn by subtracting the benefit at mean levels from living in the conflict zone for children born after the conflict (the average effect of $\hat{\beta}_3$) from the average probability of stunting for children born outside the conflict zone aged 16 months and above. The treatment effect can be illustrated by the shaded area which marks the difference between the solid and the dashed red lines.

4.2 Further geographic conflict analyses

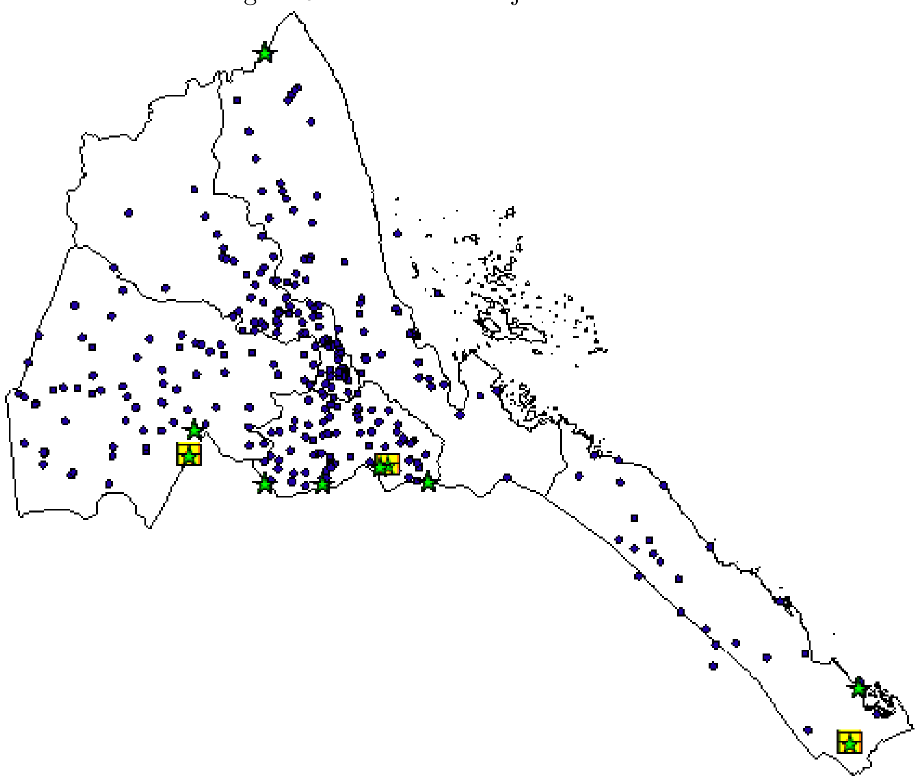
One possible improvement on the precision of the Akresh, Lucchetti, and Thirumurthy study is to use a more fine-tuned conflict indicator than their three hot-spots. The ACLED database provides an excellent starting point for making a more fine-tuned scale. Analyses were attempted where all events were included with different interactions of distance to an event and the number of fatalities it represents. None of these turned out significant. A second approach was to identify the major conflict points in the ACLED database, and those with 100 or more fatalities were used (23 events in 10 locations). Regressions with 50 km radius of these conflict locations did not provide a significant differences-in-differences conflict effect, whereas with 25 km a coefficient of 0.241 with p-value 0.075 was found. The conflict sites suggested by Akresh, Lucchetti, and Thirumurthy thus seem to be relatively well-functioning, at least compared to my best available alternative. The locations of the major ACLED conflict sites with my adjustments as described in Appendix A and the three hot-spots from Akresh, Lucchetti, and Thirumurthy are shown in figure 8.

That the adjusted ACLED conflict events did so poorly in explaining the geographic variation in stunting could be due to problems of data quality, yet is perhaps more probably due to that the issue of linking war to child stunting is more complex than the attempted modeling has allowed for. To better understand the spacial determinants of stunting, an inductive methodology was attempted. By observing how different sub-zobas were affected by conflict given common controls, one could potentially discover where the major conflict effects were located and thereby develop a more suitable theory. There are 61 sub-zobas in the sample, and sub-zobas were chosen rather than clusters because the number of children in each cluster was too low. I ran the following probit regression:

$$Stunted_{ijt} = \beta_{1j}(SubZoba_j * Born\, During\, or\, Before\, War_t) + \beta_{2j} SubZoba_j + \beta_3 X_{it} + \epsilon_{ijt} \quad (12)$$

Where X_{it} is as in equation (11) on page 29 and standard errors are clustered on sub-zoba level. Using the results, the sub-zobas were divided in observations

Figure 8: Location of major conflict sites



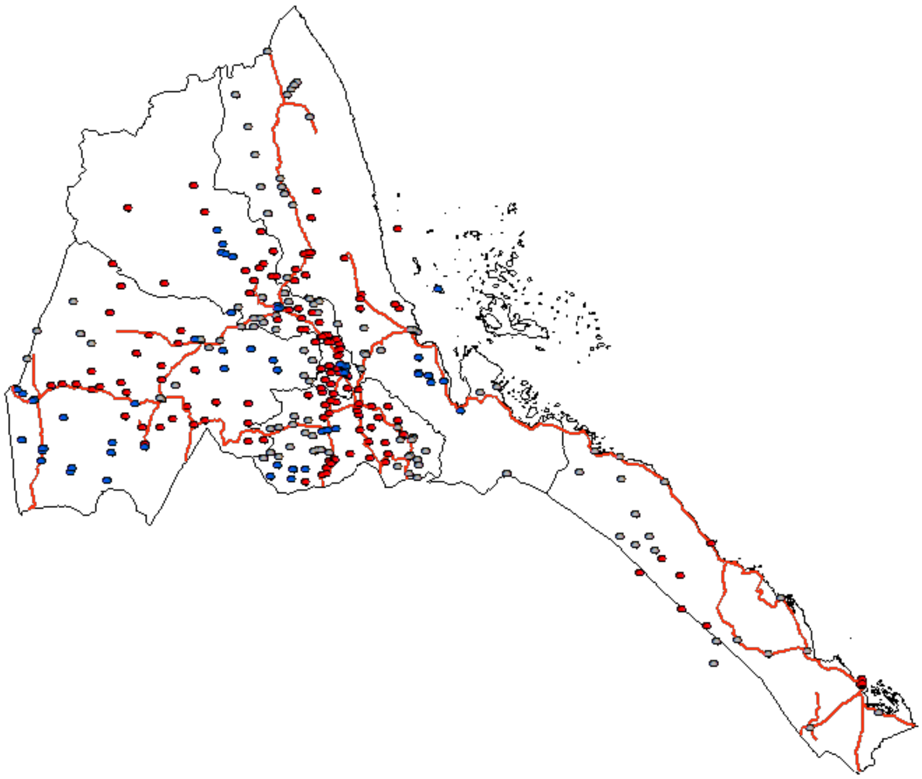
Green stars indicate ACLED conflict events with more than 100 fatalities. Yellow squares indicate three conflict locations as suggested by Akresh, Lucchetti, and Thirumurthy. Blue dots indicate DHS cluster locations.

where $\hat{\beta}_{1j}$ was significant and positive, where $\hat{\beta}_{1j}$ was significant and negative, and where $\hat{\beta}_{1j}$ was not significantly different from 0 at the 5 % level. The results are mapped in figure 9 with major roads indicated. It provides inspiration for studying other conflict effects than closeness to war sites, which is presented in the next section.

4.3 A model with multiple conflict effects

This section will present a more complete model of how conflict has affected stunting in Eritrea. It is an attempt to explore other linkages between conflict and stunting than geographic closeness to war sites. I will first consider how disruption of markets because of the war have affected stunting, before moving

Figure 9: Location of clusters with different conflict effects



Blue dots indicate significant negative effects of conflict on stunting, red dots indicate significant positive effects and grey dots indicate no significant effect.

on to effects that have affected single households.

4.3.1 Conflict and market dependency

From figure 9, a pattern emerges of a conflict effect that might not be connected to distance to conflict locations. First, it seems to be the case that children in major cities are less affected by conflict than others, as indicated with the blue spots representing patterns in stunting probabilities not consistent with a conflict effect on Asmara, Keren, Mendefera and Tesseney and grey spots indicating a non-conclusive effect of conflict on Akordat, Barentu and Massawa. Assab and Dekemhare are the only major cities with red spots, consistent with a conflict effect. Assab was heavily bombarded during the war, and its economy was almost completely dependent upon trade with Ethiopia. Dekemhare was a major destination of IDPs from a large and densely populated area, with towns that were completely devastated during the war, such as Tsorona and Senafe. Other children that fared relatively well during the conflict tend to reside in very remote places. However, along roads and outside cities, there seems to be a larger conflict effect. This seems especially to be true where the main trading route before the war was with Ethiopia, rather than with the Sudan or across sea. My hypothesis is that households highly dependent upon trade with Ethiopia for food and livelihoods who did not have the benefit of living in urban centres where the shortfall of Ethiopian trade could be substituted with trade from other locations fared worse than other households during the conflict. This is particularly relevant in the Debub region, as the three major roads in the region all connect Ethiopia with Asmara. In Gash-Barka, a major trading route goes through the Sudan, whereas the Northern and Southern Red Sea regions have access to trade across sea. The international trade in goods in the Maekel and Anseba regions is probably foremost connected to trade first going through Asmara before being connected to international markets. The effect of conflict through restricted market access will therefore be operationalised by the logged distance of the cluster to a road outside Mendefera in the Debub region.

4.3.2 Idiosyncratic effects

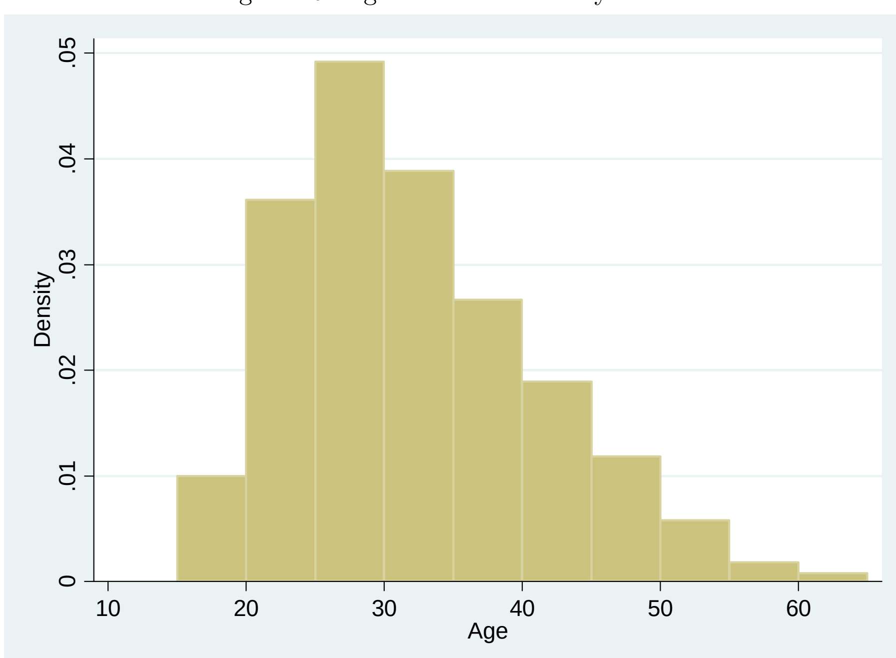
There may also be idiosyncratic effects of conflict that are not captured in the geographic conflict models. As argued in chapter 2, the absence of males and displacement are particularly thought to have an effect on child stunting. A distinction is made between households with mobilised men and where men have died. Data is available on occupation, which has a designation 'Miltary (Police, Army, Navy, Airborne)'. Table 8 shows summary statistics of the labour force in Eritrea.

Table 8: Labour force in Eritrea, by occupational group

	Men (frequency)	Men (percent)	Women (frequency)	Women (percent)
Not working	4	0.05 %	1	0.04 %
Other white-collar	456	3.74 %	195	8.76 %
Clerical	100	0.82 %	136	6.11 %
Sales	449	5.07 %	309	13.89 %
Agricultural	3078	34.79 %	602	27.05 %
Military	3396	38.38 %	216	9.71 %
Non-military services	314	3.55 %	99	4.45 %
Manual	994	11.23 %	235	10.56 %
Not known	57	0.65 %	34	1.52 %
Total	8848	100 %	2225	100 %
Outside labour force	6582	42.66 %	13697	86.03 %
Population over 10 years	15430		15922	

Labour force defined as having worked last year.

Figure 10: Age of men in military service



Finding households with men who are likely to have died as a result of the border war was not as straight forward. Caution has to be taken not to include men who might as well have died in the independence war from 1974-1991. Three indicators will be used:

- Households where a father of a child aged 1-10 years is dead.
- Households where a mother reports having lost a son during 1998-2000 with the son being above 18 at death.
- Households where a man aged 18-54 at time of death has died in 2000.

Concerning the IDPs, a clear deficit in the DHS survey is that whether the household has been displaced and then returned is not indicated. The effect on IDPs is therefore mainly thought of as operating through the geographic estimation. However, households where a woman reports that she has moved to her current location because of the war and households that report to be hosting IDPs could possibly also shed light on the effect of displacement.

4.3.3 Results

Table 9 summarises the extended framework for studying the effect of conflict on stunting.

Table 9: Hypothesised conflict effects

	Frequency	Percent
Close to War Site * Born During War	532	9.48 %
Close to War Site * Born Before War	213	3.80 %
ln(Distance to Road in Debub) * Born During War	622	11.08 %
ln(Distance to Road in Debub) * Born Before War	272	4.85 %
Mobilised Male Member	1956	34.85 %
Dead Male Member	309	5.50 %
Internally Displaced	302	5.38 %
Not geographically affected	3879	69.12 %
Not idiosyncratically affected	3274	58.34 %
Total	5612	100 %

Not geographically affected defined as being outside the conflict zone and outside Debub.

The regression yielded the following results:

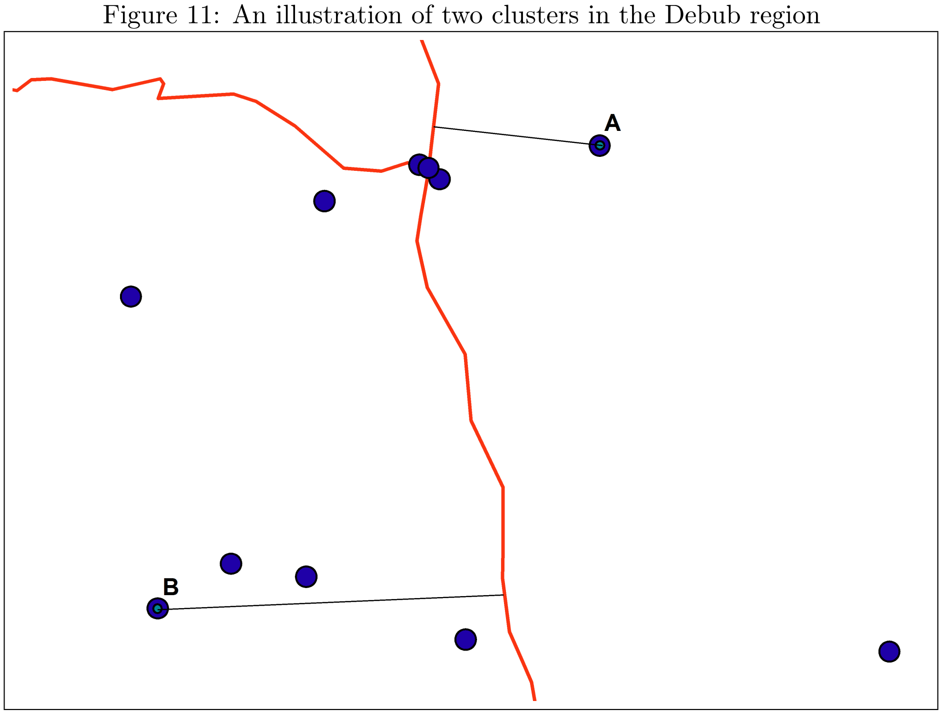
Table 10: The impact of conflict on probability of being stunted

Probit, dependent variable: Stunted	(9)	(10)
Within 50 km of War Site * Born During War		0.328**
		(0.133)
Within 50 km of War Site * Born Before War		0.164
		(0.160)
Within 50 km of War Site		–0.214
		(0.138)
ln(Distance to Road in Debub) * Born During War		–0.133**
		(0.052)
ln(Distance to Road in Debub) * Born Before War		–0.083
		(0.057)
ln(Distance to Road in Debub)		0.147***
		(0.046)
Mobilised Male Member	–0.011	–0.017
	(0.044)	(0.044)
Dead Male Member	–0.017	–0.027
	(0.095)	(0.094)
Internally Displaced	–0.189	–0.176
	(0.126)	(0.125)
Mendefera * Born During War		2.936***
Mendefera * Born Before War		3.310***
Mendefera		–3.718***
Female	–0.046	–0.048
Age in Months	0.853**	0.857**
Age^2	–0.024*	–0.024*
Age^3	0.0002	0.0002
Mother Height	–0.005	–0.005
No Data on Mothers	–0.193	–0.248
Mother Height*Age	–0.004*	–0.004*
Mother Height*Age^2	0.0001	0.0001
Mother Height*Age^3	$-9.02*10^{-7}$	$-9.06*10^{-7}$
No Data on Mothers*Age	–0.019	–0.012
No Data on Mothers*Age^2	0.0007	0.0005
No Data on Mothers*Age^3	$-5.84*10^{-6}$	$-4.36*10^{-6}$
Constant	–1.575	–1.592
Observations	5612	5612
Pseudo R-squared	0.1250	0.1287

Robust and clustered standard errors in brackets. * significant at 10 %, ** significant at 5 %, *** signficant at 1 %.

To illustrate how market dependence (measured as the logged road distance in kilometers) has mediated the effect of conflict on stunting in Debub, the fuzzy differences-in-differences design will best be explained by considering two villages, called A and B. The distance to the closest road for these villages are 6.6 and 13.7 kilometers respectively, which also equals the mean distance to the road for households outside Mendefera in Debub, and the mean plus one standard deviation. These are thus illustrative examples but also real clusters from the dataset, and their locations are shown in figure 11.

Figure 11: An illustration of two clusters in the Debub region



The regression results tell us that for children born after the war, representing the non-treated situation, we would expect fewer children in village A to be stunted than in village B. The households in village A probably have better access to education, health services, clean water, and markets for both selling their goods or labour and buying food. However, this very benefit during peace-time also means that they are more dependent upon markets than the villages further away. The logged distances are thus used as a proxy for how hard the two villages are hit by conflict, or the strength of the treatment. We find that there is a conflict effect, as the children born during the war in village

A display a higher probability of being stunted compared to their younger fellow villagers than children in village B, who have a more equal probability of being stunted if born during or after the war. If village B would have experienced the conflict effect of village A, the probability of stunting for children born during war in village B would have been 8.6 % higher, from an estimated 53.4 % to a counter-factual 62.0 %. For these calculations, other variables are kept at mean values.

Another observation from our results is that the conflict effect of living within 50 kilometers from the war sites has remained as strong both in size and significance as when the market dependency effect was not taken into account (see table 7 on page 30), and is if anything stronger rather than weaker. The two effects of conflict on stunting are thus relatively independent of each other and operate simultaneously, rather than being competing theories to explain the same variation.

More surprisingly, none of the idiosyncratic shocks were significant and did not even have the expected sign. That could be the result of two factors. Either, being affected by a death or mobilisation or being among those who remained displaced in 2002 did not represent a financial burden for the households. Or, the idiosyncratic shocks had dual effects: mobilisation and death in the family may represent a financial burden which would in isolation lead to more stunting, yet widows and wives of absent men gain in decision-making power or compensate for the loss by working which reduces stunting. To study these effects, chapter 5 will present analyses of determinants of wealth and female labour participation in Eritrea.

5 Households' strategies for coping with conflict in Eritrea

This chapter will take four approaches to how households altered behaviour and coped with the threats that conflict represents for food security and child health. A starting point is to find out whether any of the conflict effects have influenced household wealth and female labour participation. Effects of conflict on household wealth will tell us whether a household has sold assets and / or invested less due to the conflict, and will thereby also function as an approximation of effects of conflict on income. Female labour participation will be studied as another form of income smoothing, and I am more specifically interested in whether a shortfall of income from men due to the war was compensated by female workers.

The third approach will return to the effect of conflict on stunting to study whether the effect on stunting of own wealth, community wealth and owning crop land differed among those affected by conflict and those that were not. This will give an indication of which coping strategies are in function to cope with crises, and whether different strategies were useful in strengthening child health during the war compared to other situations.

The last analysis considers fertility as a coping strategy. This analysis seeks to link two important findings. As we have shown, the conflict placed many families under economic distress, with child stunting as a manifestation. At the same time, fertility was significantly reduced in the 1995-2002 period, and there is some controversy over whether that was a conflict-induced effect. Could these two factors be related? To answer this question, the last section considers the effect the last-born child being stunted on both actual fertility and the fertility preferences of mothers.

5.1 Determinants of wealth and female labour force participation

The wealth index found in the DHS survey is based on household ownership of a number of consumer items ranging from a television to a bicycle or car, as well as dwelling characteristics such as source of drinking water, sanitation facilities, and type of material used in flooring (National Statistics Office of Eritrea and ORC Macro (2003); see Rutstein and Johnson (2004) for discussion). Based on these observations, a wealth factor with mean of 0 and standard deviation of 1 is given to each household, and a wealth index dividing the households into quintiles is created. For increased variability, the wealth factor will be used as dependent variable. It is important to keep in mind that this is the stock value of a composite index measured at the time of interview. If the income of a household increases, we may expect that the household will relatively easily strengthen their holdings of some of these assets, such as a radio. Other assets might take a generation or more to improve upon if available to the household at all, such as ownership of house and cropland. If income decreases, there are still other assets that will be sold to finance consumption, such as donkeys, horses, camels, sheep and goats. However, we may not expect that assets such as the material of the floor will be sold. According to Habtom and Ruys (2007), the most common assets used for self-insurance in rural Eritrea are livestock and farm tools, as well as using saved food stocks. A clear drawback which probably is of most concern for the poorer households is that savings in farm tools and food stocks do not form part of the wealth index. Adding to the problem of studying determinants of wealth is that also other forms of wealth are excluded, most notably the holdings of jewelry and cash, which are also important liquid assets held by households in Eritrea (Habtom and Ruys, 2007). When examining the determinants of wealth in Eritrea, it is thus difficult to determine the direction of causality. Did the loss of a family member or mobilisation cause a reduction in the wealth factor, or were households selected into mobilisation and morbidity due to their social status? At least with the more liquid assets that are included, the direction should be quite clear, as most of the mobilised except for the youngest have probably been mobilised since the start of the war, and the diseased men have all died at least one year before the survey. Due to the concern about causality, the analysis will be attempted with controls that can hopefully capture most of the variation which is not due to causal effects of conflict. Controls that will be exercised are female height, whether a member is literate, the highest level of education obtained by a member (none, primary, secondary or higher), whether the household is within a major city or smaller town, and administrative region. Results are shown in table 11.

The analysis points to a sharp distinction between the effect of mobilisation and of death to the family. Whereas the household wealth does not seem to be affected by having members sent to the military, there is a significant and four times larger negative effect of losing a male household member in the war. Recall from table 10 on page 39 that the effect of these two events were to

Table 11: The impact of conflict on household wealth

OLS, dependent variable: Household Wealth	(11)
Mobilised Male Member	–0.014
	(0.013)
Dead Male Member	–0.060***
	(0.017)
Internally Displaced	0.029
	(0.055)
Within 50 km of War Site	0.280***
	(0.062)
Female Height	0.005***
No Data on Females	–0.011
One or More Literate Members	0.081***
Primary Education Highest Completed in Household	–0.021
Secondary Education Highest Completed in Household	0.389***
Higher Education Highest Completed in Household	0.870***
City	1.650***
Town	1.040***
Central / Maekel	–0.104
Northern Red Sea / Semenawi Keih Bahri	–0.364***
Anseba	–0.358***
Gash-Barka	–0.445***
Southern / Debub	–0.315***
Constant	–1.190***
Observations	9382
Adjusted R^2	0.7418

Robust and clustered standard errors in brackets. * significant at 10 %, ** significant at 5 %, *** signficant at 1 %.

reduce the probability of stunting if having any effect at all. It thus seems to be the case that significant gains in child care compensate for the financial burden of losing a male household member during war in terms of child growth or well-being. Regarding mobilisation, it does not seem to place a large financial burden upon the households. We may conclude that it is quite plausible that the salary soldiers received prior to 2002 matched market wages pretty well on average, although there may be sub-groups that were paid less or more than they otherwise would have gained. Notice also that the model does relatively well in explaining the variation in household wealth, with an adjusted R^2 of 0.74. That strengthens the claim of having controlled for most confounding factors. It is furthermore surprising that closeness to war sites had such a large and significant positive effect. This is probably due to a combination of factors, such as the area being relatively fertile, that reconstruction after the border war was quite successful as to re-establishing livelihoods in the immediate post-conflict years, and a commonly found selection effect in returnee populations where the most resourceful are less likely to flee and are often the first to return (Pivovarova and Swee, 2011).

A second analysis runs the same regression by wealth index quintiles. There are several reasons why such an analysis is fruitful. One is that variations within a quintile are likely to be more affected by alterations in liquid assets, as the households have a more similar social status. Secondly, mobilisation is likely to have had an equalising effect on household income, raising expectations of a negative effect on household wealth for the richer and a positive effect for the poorer.

Table 12: The impact of conflict on household wealth, by wealth index quintile

Wealth quintile	Lowest (12)	2nd (13)	3rd (14)	4th (15)	Highest (16)
Mobilised Male	0.007	0.004	0.001	–0.013	–0.081**
	(0.005)	(0.003)	(0.005)	(0.018)	(0.032)
Dead Male	–0.003	–0.002	–0.017**	–0.043*	–0.078*
	(0.007)	(0.004)	(0.008)	(0.024)	(0.046)
Displaced	–0.011	0.0004	0.018*	0.049	–0.060
	(0.013)	(0.006)	(0.009)	(0.031)	(0.046)
Within 50 km	0.003	0.001	–0.003	0.044	0.018
	(0.009)	(0.004)	(0.008)	(0.053)	(0.056)
Female Height	–0.0004	0.0004*	0.0004	0.002	0.004
No Data on Females	0.013***	0.010***	–0.009*	–0.050***	–0.042
Literate Members	0.002	0.002	–0.009	0.091**	0.173
Primary Educ.	–0.004	–0.005	0.018**	–0.065	–0.129
Secondary Educ.	–0.004	–0.004	0.037***	0.025	0.113
Higher Educ.	–0.014	0.015	0.036	0.148***	0.444***
City	NA	NA	0.120***	0.454***	0.631***
Town	0.064***	0.022***	0.053***	0.314***	0.144
Central	–0.004	–0.017**	0.070***	–0.068	–0.410***
Northern Red Sea	–0.049***	–0.027***	0.024*	–0.205**	–0.196*
Anseba	–0.047***	–0.032***	0.014	–0.260***	–0.178**
Gash-Barka	–0.039***	–0.025***	0.021*	–0.320***	–0.335***
Southern	–0.009	–0.011**	0.039***	–0.119	–0.270***
Constant	–0.761***	–0.670***	–0.489***	–0.023	0.796
Observations	1755	2270	2143	1541	1673
Adjusted R^2	0.0528	0.0506	0.0786	0.3657	0.1537

OLS regression, with the household wealth factor as dependent variable. NA means not available, the variable is omitted due to no observations. Robust and clustered standard errors in brackets. * significant at 10 %, ** significant at 5 %, *** signficant at 1 %.

Table 12 clearly confirms the equalising effect of mobilisation; the more wealthy a household is, the more negatively it is affected by mobilisation. Only the highest quintile is clearly negatively affected by mobilisation. For male deaths to the household due to war, the upper three quintiles show a significant negative effect, which is also increasingly negative. This could be because male labour can more easily be substituted by other household members for the lower quintiles. It could also be that the lower quintiles lack assets that can be used to maintain consumption when an income source is lost. For all households but the highest, losing a household member is financially worse than having a member in the military. Notice also that the model has very low predictive value for the lowest three quintiles.

Studying the effects of conflict on female labour participation will shed further light on what adjustments households have undertaken to cope with the conflict. Did women compensate for the absence of males in household production? And specifically, would fewer women have worked if the male household members had civilian jobs rather than being soldiers? To test these hypotheses, the ratio of male workers and male soldiers per household member are regressed on the probability for women to participate in the labour force. Controls capture socio-economic status, female empowerment and age. Female empowerment is measured by literacy, highest completed education and attitudes to wife beating, which equals 1 if the woman does not agree to any of five justifications. Urban and regional controls are also included. As some controls are from the women's questionnaire, only women in reproductive age (15-49) are included.

Table 13: Determinants of female labour force participation

Probit, dependent variable: Worked Last Year	(17)
Male Workers per Household Member	–0.793***
	(0.187)
Male Military Workers per Household Member	0.574***
	(0.195)
Literate	0.220**
Primary Education Highest Completed	0.072
Secondary Education Highest Completed	0.361***
Higher Education Highest Completed in Household	0.940***
Objects to Wife Beating	–0.029
City	0.627***
Town	0.198*
Age in Years	0.109***
Age^2	–0.001***
Central / Maekel	–0.852***
Northern Red Sea / Semenawi Keih Bahri	–0.994***
Anseba	–1.181***
Gash-Barka	–0.670***
Southern / Debub	–0.772***
Constant	–2.404***
Observations	9020
Pseudo R^2	0.1490

Robust and clustered standard errors in brackets. * significant at 10 %, ** significant at 5 %, *** signficant at 1 %.

From table 13, it is evident that women are substituting with their own labour participation for lack of male workers, and for mobilised males. The average household of a woman included in the regression has 5.68 members. To determine the size of the effect of losing a male worker, the effect is measured around the mean of 1.01 workers as a reduction from 1.51 to 0.51 workers, which equals a reduction in the ratio from 0.266 to 0.090. Keeping all other variables at mean values, that equals an increase in the probability of working of 3 %, from 12.1 % to 15.1 % . The sample mean number of mobilised male members is 0.39, and in order to avoid negative numbers, the impact of having one more male member mobilised will be measured from 0 to 1, with the ratio increasing to 0.176. That creates an increase in the probability of working of 2.2 %, from 12.5 % to 14.7 %. The effect of losing a working male member to mobilisation is not significantly different from losing a male worker altogether in terms of the effect on female labour participation, although the average effect is somewhat smaller (Chi-squared test yields p-value 0.188). That absent males are substituted for by women suggests that losing a male worker both due to death and mobilisation is a financial burden for the household, or that new or better opportunities for female labour participation arise from the absence of males. Together with the observation that the effect of mobilisation on household wealth is small and insignificant, the conclusion must be that the latter mechanism is particularly strong for this group. One should notice that very few women in Eritrea generally report to be working, and that the extent of labour substitution for absent males is quite small, although highly significant. Low levels of reported female labour participation is a general problem in DHS surveys, as work that is casual, intermittent, part-time, home-based or unremunerated is generally not reported by the female respondents (Langsten and Salem, 2008).

5.2 Coping strategies

This section will answer the question of which coping strategies or adjustments in household behaviour mitigated the effect of conflict on stunting. It will adapt a strategy of comparing effects of coping strategies on the probability of stunting for children born during the war within 50 km of a war site to children outside the conflict zone. Of particular interest is whether community-based assistance has played a role in reducing stunting, and whether these assistance systems have functioned differently for children affected by conflict. Two measures of community assistance will be used. The average wealth index for households in the same cluster excluding the household in question should have a negative effect on stunting if households assist each other financially. A second measure follows the hypothesis that more egalitarian communities have a higher level of social coherence and therefore have stronger mutual insurance systems, and that the standard deviation of the wealth factor in the cluster should therefore have a positive effect on stunting. Finally, as suggested by the finding that marked-dependent households fared worse, whether the household has agricultural land to produce food on its own might be of importance for the vulnerability of the household.

Table 14: The effects of coping strategies on the probability of being stunted

Probit Dependent variable: Stunted	Conflict Affected (18)	Reference Group (19)	Difference (20)
Household Wealth Factor	–0.628***	–0.269***	–0.359**
	(0.137)	(0.067)	(0.152)
Cluster Average Wealth	0.295*	–0.138*	0.433**
	(0.186)	(0.078)	(0.201)
Cluster Standard Deviation	0.259	0.484**	–0.226
	(0.704)	(0.273)	(0.751)
Owning Crop Land	–0.434***	–0.012	–0.422**
	(0.187)	(0.058)	(0.195)
Female	–0.057	–0.040	–0.017
Age in Months	11.056	0.739*	10.317
Age^2	–0.333	–0.020	–0.313
Age^3	0.003	0.0002	0.003
Mother Height	0.668	–0.007	0.675
No Data on Mothers	60.819**	0.136	60.683**
Mother Height*Age	–0.068	–0.003	–0.065
Mother Height*Age^2	0.002	$-8.54*10^{-5}$	0.002
Mother Height*Age^3	$-1.93*10^{-5}$	$-6.90*10^{-7}$	$-1.86*10^{-5}$
No Data on Mothers*Age	–5.334**	–0.070	–5.263**
No Data on Mothers*Age^2	0.151**	0.003	0.148**
No Data on Mothers*Age^3	–0.001**	$-2.72*10^{-5}$	–0.001**
Constant	–107.608	–1.503	–106.106
Observations	532	4549	5081
Pseudo R-squared	0.0844	0.1464	0.1438

Conflict affected refers to children born within 50 km from a war site during the conflict. The reference group are children born outside the conflict zone. The cluster average wealth is average wealth in cluster excluding the household in question. Robust and clustered standard errors in brackets. * significant at 10 %, ** significant at 5 %, *** signficant at 1 %.

Table 14 shows the results of the two regressions and the difference between them. We see that household wealth is a strong determinant of stunting, both for the conflict affected and the reference group. The effect is more than twice as large for the conflict affected than for the reference group, a significant difference. Conflict-affected households thus seem to rely more on own assets for emergency consumption than other households. In the reference group, the wealth of the neighbours generally reduces the likelihood for stunting, although the relationship is relatively weak with a p-value of 0.074. In addition, there is a significant and relatively strong effect of equality, where more equal clusters perform better in protecting their children from stunting. When faced with conflict, these mechanisms seem to break down. Having more wealthy neighbours now leads to a higher risk of stunting, if having any effect at all. The effect of average cluster wealth is significantly different for the conflict affected than for the reference group. The positive gain from equality is also no longer significant. Also, a highly significant and strong effect of owning cropland beyond its effect through wealth is found for the conflict affected, but not for the reference group. This strengthens the impression that households affected by conflict mostly had to rely on their own wealth and food production as coping strategies, whereas other households at risk may take greater advantage of markets and community assistance for emergency consumption.

5.3 Fertility

The 2002 DHS survey created some controversy regarding whether the rapid fertility decline observed between 1995 and 2002 forms part of a demographic transition or is a temporary delay in births due to conflict. From 1995 to 2002, the total fertility rate declined from 6.1 children per woman to 4.8, a decrease of 21 percent (National Statistics Office of Eritrea and ORC Macro, 2003). There are two papers on the causes of fertility decline in Eritrea that differ in their findings. Blanc (2004) argues that absence of men and fewer marriages due to conflict combined with no increase in contraceptive use suggests a conflict effect on natural fertility. Woldemicael (2008) on the other hand points to a stronger reduction among higher-parity births, that the reduction in higher-order births started prior to 1998, and that the two most conflict-affected zobas (Gash-Barka and Debub) do not show a unique fertility decline. A hypothesis which is conciliable to both explanations is that lower fertility could be a reaction to budget constraints, which are worsened by conflict. Adjusting fertility would then be an additional coping strategy adopted in response to conflict, which would imply that a post-conflict baby boom is to be expected if human security improves. To test such a hypothesis, we will use stunting as an indicator of inadequate coverage of basic child needs, or a strained household budget situation. Our regression will estimate how the probability for having one more child is affected by whether the last born child is stunted. We thus need to restrict our sample of last births to be within the last five years as that is where we have data on stunting, and downwards to 10 or more months to allow for a hypothetical chance of an additional birth.

Table 15: The effect of stunting on probability of having one more child

Probit, dependent variable: Having One More Child	(15)
Last Child Stunted	–0.202***
	(0.044)
Last Child Dead	0.511***
	(0.083)
Husband Absent	–0.547***
	(0.054)
Literate	–0.039
Primary Education Highest Completed	–0.012
Town	0.141
City	0.353*
Central / Maekel	0.089
Northern Red Sea / Semenawi Keih Bahri	–0.005
Anseba	0.108
Gash-Barka	–0.125*
Southern / Debub	0.115*
Included in Financial Decisions	–0.041
Objects to Wife Beating	0.103**
Last Born Birth Order	–0.031**
Last Born Age in Months	0.146***
Last Born Age^2	–0.001***
Mother's Age	0.125***
Mother's Age^2	–0.002***
Constant	–5.273***
Observations	4449
Pseudo R-squared	0.2431

Regression on the probability of having one more child, given that the woman had at least one child between 10 and 59 months before the interview. Robust and clustered standard errors in brackets. * significant at 10 %, ** significant at 5 %, *** signficant at 1 %.

Table 15 shows expected results of absent males, and an expected replacement effect of losing a child. Most interesting is that in line with our hypothesis, we find that if the last child is stunted, the probability of having another child is significantly reduced. At mean levels, if the last child turns out stunted, that decreases the probability of having one more child by a ratio of one to five, by 7.4 % from 37.7 % to 30.3 %. Clearly, this analysis does not give a complete answer to whether the decline in fertility from 1995 to 2002 was due to conflict and whether an increase after the war is to be expected. For such an analysis, one should also take into account that the replacement effect will have a smaller impact after the war if fewer children die and that education and socio-economic development is likely to reduce fertility. However, it highlights an effect that previous studies have not taken into account: that stunting among children has a negative effect on fertility. This suggests that conflict has affected the demand for children, and not only affected natural fertility as emphasised by Woldemicael (2008), although a possible confounding factor is that malnutrition or poor health among mothers affect both stunting of children and fertility.

As the women are also asked about their fertility preferences, we may also test that the reduction in fertility due to stunting is in deed a desired outcome for the women. This is done by running a regression with the same independent and control variables, but with the dependent variable now being whether the woman wants another child or does not want or is undecided about getting another child, excluding women who are declared infecund or sterilised. Women who wanted another child were also asked whether they wanted a child within the next two years, with the reference group being women who wanted a child after two years or later, or women who wanted another child but were uncertain about timing.

From table 16, we may not conclude that women reduced their fertility desires due to stunting of the last born child, but they certainly postponed child bearing due to stunting or its causes. If the last born was stunted, that reduced the likelihood that a fertile woman who wanted more children wanted it within the next two years by 4.8 %, from 37.8 % to 33.0 %. Mothers that struggled to cover the basic needs of their last born child during the conflict thus seem to have postponed further births, possibly to take better care of the children they already had. If not adjusting their desire for child-bearing yet adjusting their desired timing, the isolated effect of child stunting on fertility suggests a post-conflict baby boom if the food security and health situation improves. Losing a child clearly increases preferences for both having more children and for having them sooner. The effect of absent husbands is somewhat more difficult to interpret. This effect is mainly thought to be a supply effect, yet the results suggest that the absence of husbands also reduced the desired number of children. However, among those that did wish to have more children, it increases the probability that they wished to have children sooner rather than later. The reason for such a finding could simply be that wives with absent husbands had already unwillingly postponed child-bearing.

Table 16: The effect of stunting on fertility preferences

Probit	Wants More Children (21)	Wants Child Soon (22)
Last Child Stunted	–0.054	–0.130**
	(0.062)	(0.066)
Last Child Dead	0.413***	0.659***
	(0.105)	(0.123)
Husband Absent	–0.228***	0.145**
	(0.057)	(0.063)
Literate	–0.126	–0.104
Completed Primary Education	0.184	–0.066
Town	0.290	–0.633***
City	0.442**	–0.367*
Central	0.438**	–1.290***
Northern Red Sea	0.457***	–0.801***
Anseba	0.422***	–0.751***
Gash-Barka	0.197	–0.879***
Southern	0.433***	–0.980***
Included in Financial Decisions	0.098*	–0.001
Objects to Wife Beating	–0.180***	0.114*
Last Born Birth Order	–0.162***	–0.032*
Last Born Age in Months	0.0002	0.062***
Last Born Age^2	–4.36*10^{-5}	–0.001***
Mother's Age	0.068**	–0.033
Mother's Age^2	–0.001***	0.001*
Constant	0.071	0.099
Observations	3567	2569
Pseudo R-squared	0.1554	0.1718

Regression on fertility preferences of fertile women with at least one birth 59 months or less from the interview. Robust and clustered standard errors in brackets. * significant at 10 %, ** significant at 5 %, *** signficant at 1 %.

6 Conclusion

This thesis arrives at a set of methodological conclusions, and a set of empirical ones. The methodological conclusions call for a few improvements on previous studies on the relationship between war and child growth. An important message is that any hypothesis on such a relationship should take the underlying causes of growth retardation as a starting point, meaning that effects should operate through food shortages, a deteriorating health environment, or changes in maternal and child care. The thesis therefore calls for making a clear distinction between child stunting in growth, which can be explained through the underlying causes, and their height for age, where most of the variation cannot be explained, even in societies that are heavily affected by stunting. It furthermore identifies and tackles multicollinearity problems in the previous study by Akresh, Lucchetti, and Thirumurthy (2010) by improving controls on child age and other confounding variables. Another highlighted problem relates to robustness in the conflict indicator of the previous study which uses distance to three war sites. However, it is here argued that the problem is due to regression mis-specifications rather than the conflict indicator itself, and the thesis comes short of finding a convincing usage of the ACLED database to replace it. The latter could be due to problems of data quality which has also been attempted to improve upon, yet is perhaps more probably due to that the issue of linking war to child stunting is more complex than the attempted modeling has allowed for. To better understand the spacial determinants of stunting, the thesis argues for and attempts an inductive method, which highlights the importance of market dependency for the impact of conflict on child stunting.

The first important empirical finding is that the border war raised levels of stunting in affected regions by 12 %, which is more than a quarter of the non-conflict level. One in five stunted children living close to the war site became stunted due to the border war between Ethiopia and Eritrea. For children in this region, we may conclude that the war worsened an already precarious food and health situation yet is not the main threat to food security and child health. We furthermore did not find any significant and negative effects of the idiosyncratic shocks of mobilisation, war-related deaths among male family members, and displacement still ongoing in 2002. Thirdly, this thesis finds that the levels of stunting among children in the Debub region were significantly more severely affected by conflict if living closer to a main road, indicating that dependency on trade with Ethiopia was an important risk factor. The conclusion still remains that the generally unfavourable situation for children in Eritrea is the main factor causing stunting, also among the conflict affected. If studying child well-being in the Horn of Africa, this thesis would thus caution against an excessive focus on physical security as a determinant and rather favour a more holistic approach where multiple and inter-linked factors such as droughts and famines, underdevelopment, environmental degradation, the status of women and decades of war are examined.

The analysis of coping strategies in this thesis further develops the idea that the conflict-stunting relationship is asymmetric and highly influenced by the options available to households in mitigating the effects of negative shocks. Consistent with economic theory, community assistance or mutual insurance systems do a much better job in mitigating crises with repeated risk exposure and when facing idiosyncratic risk than in an extraordinary conflict situation. Stunting due to war is significantly more dependent upon the ability to convert own wealth into emergency consumption and on growing own crops than stunting due to other causes. These findings point to a breakdown in social contracts during war, which is particularly problematic for the most vulnerable.

Of particular interest in this thesis has been the role of Eritrean women in mitigating the effects of war. Eritrean women have to a significant degree substituted for the labour of men in general, and also for mobilised men. However, the rate of female labour participation as reported in the 2002 DHS remains low, possibly due to under-reporting. The level of fertility during the 1998-2002 time period was lower in families that were not able to secure the basic needs of their last-born child still alive, of which stunting is a manifestation. Mothers of stunted children have furthermore wanted to postpone further childbearing which implies that a significant part of the reduction has been a desired adjustment for the mothers, yet they have not necessarily reduced their overall fertility desires.

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A Corrections to the ACLED database

Table 17: Corrections to the ACLED database

ObjectID	EventDate	Location	NewLatitude	NewLongitude	OldLatitude	OldLongitude	News Source	Fatalities
175	2.9.1999	Dedda	15.3107	37.648	15.233333	27.58333	Reuters News	5
183	2.14.1999	Bure	12.6	42.6667	10.7	37.06667	BBC Monitoring Newsfile	3
215	3.26.1999	Mereb / Igremekel	14.6367	39.1984	15.08333	37.16667	Infantry FINF Vol. 89. Issue 2	13700
217	3.29.1999	Mereb / Igremekel	14.6367	39.1984	15.08333	37.16667	All Africa	3400
241	5.24.1999	Mereb	14.511	38.3616	15.08333	37.16667	Infantry FINF Vol. 89. Issue 2	780
243	5.26.1999	Mereb	14.511	38.3616	15.08333	37.16667	BBC Monitoring Africa	865
244	5.26.1999	Mereb	14.511	38.3616	15.08333	37.16667	BBC Monitoring Africa	865
246	6.9.1999	Bure	12.6	42.6667	10.7	37.06667	All Africa	50
247	6.9.1999	Bure	12.6	42.6667	10.7	37.06667	BBC Monitoring Africa	50
249	6.10.1999	Bure	12.6	42.6667	10.7	37.06667	All Africa	480
251	6.11.1999	Mereb / Elala Shambuko	14.91861	37.83472	15.08333	37.16667	Xinhua News Agency	42450
257	6.17.1999	Mereb / Elala Shambuko	14.91861	37.83472	15.08333	37.16667	BBC Monitoring Africa	2
259	6.25.1999	Mereb / Elala Shambuko	14.91861	37.83472	15.08333	37.16667	Xinhua News Agency	2050
261	6.26.1999	Mereb / Elala Shambuko	14.91861	37.83472	15.08333	37.16667	BBC Monitoring Africa	4000
268	6.29.1999	Mereb / Elala Shambuko	14.91861	37.83472	15.08333	37.16667	BBC Monitoring Africa	2501
284	10.29.1999	Bure	12.6	42.6667	10.7	37.06667	BBC Monitoring Africa	2
285	11.1.1999	Bada	14.5039	40.1906	7.91667	39.38333	Africa Research Bulletin	17
289	11.29.1999	Debre Selam	16.3336	37.9	8.25	40.13333	BBC Monitoring Newsfile	3
297	2.23.2000	Bure	12.6	42.6667	10.7	37.06667	Reuters News	200
325	5.15.2000	Mereb / Shambuko	14.91861	37.83472	15.08333	37.16667	Xinhua News Agency	2
327	5.16.2000	Mereb / Shambuko	14.91861	37.83472	15.08333	37.16667	Reuters News	1002
371	5.23.2000	Mereb / Shambuko	14.91861	37.83472	15.08333	37.16667	BBC Monitoring Africa	4
374	5.25.2000	Mereb / Shambuko	14.91861	37.83472	15.08333	37.16667	BBC Monitoring Africa	6900

Here follows an explanation to the changes made:

- Event 175 was placed in the Sudan, yet concerns an Ethiopian bombardment on an Eritrean village. The new location corresponds to Dedda, Gash-Barka, Eritrea according to Google Maps.

- The events 183, 246, 247, 249, 284 and 297 were placed in Bure, Amhara, Ethiopia. The correct location is Bure on the Eritrean-Ethiopian border, designated by the Boundary Commission to the Ethiopian Afar region (Eritrea-Ethiopia Boundary Commission, 2002). Coordinates are found using Google Maps.

- Event 285 was placed in Bada, Oromia, Ethiopia. The event is described as an attack by the Afar ethnic group killing Eritrean soldiers, which is unlikely to have taken place in Oromia. It was changed to a place found by Mapcarta as Badda in Northern Red Sea, settled by the Afar on the Eritrean-Ethiopian border.

- Event 289 is an event of the Eritrean Islamic Jihad Movement (EJIM) killing Eritrean soldiers. The original location is placed in Oromia, Ethiopia, an unlikely location. It was changed to the mountain Debre Selam in Anseba region, found by IndexMundi.

Events with locations stated as "Mereb" point to a location along the Gash river rather than the Mereb river. All those locations must therefore be assumed to be misplaced. The Mereb events were divided into three different locations:

- The dates and the high numbers of fatalities in events 215 and 217 makes it plausible that these events correspond to events reported by Last (2004). These events are described to occur in Igremekel, near Tsorona, 110 km south of Asmara. Although it has not been possible to locate Igremekel, a location was chosen where the road to Tsorona meets the Mereb river, exactly 110 km from Asmara and 2 km north of Tsorona.

- No record was available of events 241, 243 and 244 occurring in May 1999. Based on the database, the only reference was to the Mereb river, which thus makes the case for choosing a different location than the original on the Gash river. If occuring on the Mereb river, the events are likely to have occurred on the stretch that function as a border between Ethiopia and Eritrea. A point half-way on the Mereb river border was chosen.

- The events 251, 257, 259 and 261 of June 1999 are likely to respond to the events that Last (2004) report to be occurring in Elala. It is described as being close to the Gash river on hills overlooking the Badme plains. An Eritrean press release mentions that Elala is located in Shambuko sub-zoba (Eritrean Ministry of Information, 2011). As I was not able to locate Elala, the town of Shambuko was chosen as location, which also fits the geographical description. Last (2004) further mentions returning a year later, and reports that Eritrean military were defending the road to Barentu in May 2000, which starts at Shambuko. It was therefore also chosen as location for events 325, 327, 371 and 374.