Essays on human capital, military conflict and development in economic history

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Abbreviations

ABCC	Index that yields an estimate of the share of individuals who report a non-rounded age
2SLS	Two-stage least squares estimation
CEPAL	Comisión Económica para América Latina (United Nations Economic Commission for Latin America and the Caribbean)
COW	Correlates of War
DAC	The OECD Development Assistance Committee
GDP	Gross domestic product
GLS	Generalized Least Squares
GMM	Generalized Method of Moments
HDI	Human Development Index
IPDS	Infant protein deficiency syndrom
LDC	Least developed country
LIML	Limited information maximum likelihood estimation
NGO	Non-governmental organisation
ODA	Official development assistance
OECD	Organisation for Economic Co-operation and Development
OLS	Ordinary least squares estimation
U.S.	United States of America
UMR	Usual marketing requirements
UNDP	United Nations Development Programme
WHO	World Health Organisation
WLS	Weighted least squares estimation
WWII	World War II

Country abbreviations according to DIN ISO 3166

1. Introduction

"Development is about transforming the lives of people, not just transforming economies."
Joseph E. Stiglitz (2007)

1.1 Alternative concepts of well-being and development and the aim of this thesis

What is development and well-being all about? Can we define it in terms of monetary wealth and economic growth or is there more behind it? Many economists have tried to tackle these questions in the past. One of the most famous non-monetary approaches to development is Amartya Sen's capability approach that focuses upon individuals' capability to achieve the kind of life they want to achieve (Sen 1985). Or as Sen puts it: "Development can be seen (…) as a process of expanding the real freedoms that people enjoy" (Sen 1999, p.3). The capability to lead a good life is determined by a set of abilities, for example the ability to live to old age, to be in good health, or to participate in political discussions. These factors, in turn, are often closely linked to income, given that individuals with a higher income are, for example, more likely to be better nourished and educated (Sen 1999, p. 19). Sen's capability approach was also embodied in the Human Development Index (HDI) that was introduced in 1990 by the United Nations Development Programme (UNDP). The idea was to provide country-level data for a broad range of aspects related to human life and to allow for better comparability and measurement of well-being across countries, with a concept of welfare that goes beyond the traditional indicators such as gross national income per capita (Stanton 2007).[1] The idea that well-being is not exclusively connected with monetary wealth has become the overwhelmingly broad consensus nowadays. The OECD (2006, p. 130), for example, states that "(…) well-being is a more fundamental goal than GDP. It would be perverse to strive for faster growth of output if this entailed reducing the well-being of the current and future generations."

[1] The Human Development Index is a composite index of indicators of educational attainment, income and life expectancy and therefore includes both the monetary aspects and non-monetary aspects of well-being in a single indicator.

A broader development perspective has also been taken for the definition of the Millennium Development Goals that were established at the Millennium summit in 2000 and aimed at achieving a set of development goals until the year 2015 (which should thus, at best, be successfully reached shortly after the delivery of this thesis). The goals include the eradication of poverty and hunger, the achievement of universal primary education, the reduction of child mortality and the improvement of maternal health as well as well as the combat against HIV, malaria and other diseases. The improvement of the above-mentioned factors is viewed as crucial for increased well-being in developing countries. Some of these development goals or factors closely related to them will be principal discussion points in the subsequent chapters.

The central motivation for this thesis is to illuminate various aspects of well-being and development for a global set of countries taking a long-term perspective. The calculation of a historic HDI would be a straightforward approach. However, the necessary data is only available for certain – mostly rich – countries from the late 19th century onwards (Crafts 2002). Instead, alternative non-monetary indicators for the measurement of development-related issues – for example anthropometric indicators as a proxy for the biological standard of living and ABCC indices[2] as a proxy for educational achievements – are used to offer alternative and additional insights into development-related topics. Unlike conventional indicators of well-being, the measurement approaches applied here have the advantage that data is available for a larger range of countries and historical time periods.

As the thesis is not written as a scientific monograph but consists of five separate papers that are intended for individual publication, the subject range is quite broad. There are nevertheless some connections among the individual papers that run like a red thread through the thesis: firstly, all papers address the issue of well-being and development on a global scale. Secondly, as stated above, all of them take a rather non-monetary approach to development, thus covering a broader range of factors (e.g. health, nutrition, hygiene, etc.). Thirdly, a long-term view is taken where possible. Last but not least, anthropology plays a major role in the individual papers and therefore the

[2] The name resulted from the initials of the authors' last names (A'Hearn, Baten, and Crayen) plus Gregory Clark's, who suggested this transformation of the Whipple index in a comment on their paper. The index and measurement issues are described in detail in Appendix A.

thesis also serves as an example of how versatile anthropometric indicators can be used as an alternative to conventional ways of measuring well-being: they do not only serve as a proxy for the biological standard of living itself, but can also be a tool for differentiating between dissimilar social strata, as shown in chapter 2, or applied as an indicator of inequality, as will be done in chapter 3. While the first two papers rather focus on the determinants and development of certain development-related topics, namely educational inequality and civil war onset, the subsequent three sections focus on measures to improve development and well-being as well as their actual outcomes. As anthropometric indicators play an important role in four of the five papers, an introduction into this alternative indicator of well-being is provided below.

1.2 Measuring well-being with anthropometric indicators

The *biological standard of living* – a term that was introduced by Komlos (1985) to describe the measurement of well-being based on biological factors – is by now a well-established concept for the evaluation of welfare and poverty (Fogel 2012). Anthropometric indicators, that is, measures of human stature[3], are not only used in academic research, but also in International Organisations as these have recognised "the relevance of anthropometry throughout life, not only for individual assessments but also for reflecting the health status and social and economic circumstances of population groups" (WHO 1995). Indeed, several studies were able to show that anthropometrics can provide valuable information on important aspects of well-being and development, also for periods and countries where data on these issues is scarce (Baten 2000a; 2000b; Baten and Blum 2012; Floud et al. 2011; Koepke and Baten 2005; Komlos and Baten 1998, among others).

People who get in touch with anthropometrics for the first time often argue that height cannot be an appropriate measure of welfare since it is not only affected by environmental conditions, e.g. nutrition and health, but is mainly determined by genetics. This is partly true for individual height, although genetics only determine how tall a person could become under optimal environmental circumstances while the actual

[3] Anthropometry in general refers to the measurement of human individuals. Therefore anthropometric indicators do not only include height, but also weight for height or weight for age as well as the body mass index or mid-upper arm circumference.

prevailing conditions determine whether a human being reaches its full genetic height potential (Eveleth and Tanner 1976, p. 222). The average height of a population group, however, is an indicator for the degree of this group's well-being during early childhood. More specifically, while the variation in height between individuals might be determined by genetic factors, the variation between means of population groups is determined by the childhood environment of each population group, including nutritional, hygienic, disease and stress factors, among others (Deaton 2013, p.156; Tanner 1994). Komlos and Kriwny (2003) make this picture very clear in their essay on average height and height variation in Eastern and Western Germany before and after unification. The authors show that – although the genetic potential in both parts of Germany was uniform – West Germans became increasingly taller than East Germans over the period under study due to worsening socioeconomic, environmental and medical circumstances in the German Democratic Republic. After unification, East German males were able to catch up in terms of height with their Western counterparts. A similar finding has been reported for North and South Korea (Pak 2004). This clearly shows that anthropometric indicators are a powerful tool for the evaluation of the environmental conditions of population groups. While height measures are often used to examine differences in well-being between countries, the indicators can also shed light on different social groups within a certain region (see, for example, Baten and Böhm 2009).

The final height of an individual is determined mainly during the first years of life (Baten 2000; Eveleth and Tanner 1990; Schmidt et al. 1995). Consequently, the average adult height, which will repeatedly be used as a measure for well-being in this thesis, reflects the environmental conditions of a certain birth cohort at early *childhood*, not at the time of measurement. Moreover, as mentioned above, height is a reflection of several factors, such as the nutritional intake, health and physical activity; in short, factors that determine the *net nutrition* (Steckel 2008; Deaton 2013). It is therefore closely linked to income, as people who are deprived in terms of material well-being are also less likely to have access to highly nutritious food and medical care. But if there is a clear relationship between anthropometric indicators and traditional welfare-indicators such as GDP per capita, why don't we use these conventional measures of well-being

anyway? Firstly, anthropometric data is often available for periods and regions, for which income data is scarce, lacking, or unreliable. Moreover, it also covers income groups that are not included in income or wage data, such as slaves, clandestine workers or children, and may even reflect resource allocation at the household level (Steckel 1995, 2009). Finally, traditional purchasing-power based indicators of well-being have been criticised for not sufficiently measuring basic human needs, such as health. Despite these criticisms, it would be misleading to claim that anthropometric indicators are superior to traditional welfare measures. Particularly in rich countries with good data availability and low levels of malnutrition, monetary measures such as GDP per capita and Gini coefficients provide a good overview of levels of welfare and inequality. Anthropometric indicators should therefore be seen as a complementary tool that provides important additional insights and helps to get a comprehensive picture of historical and current developments of well-being.

1.3 Outline

The thesis comprises five sections that are intended for separate publication and are therefore referred to as papers. Three out of five papers are co-authored with Joerg Baten (chapters 2, 3, and 4). At the time of submission of this thesis, the papers of chapter two and three have been published. The other working papers are to be submitted in the near future.

The thesis is structured as follows: in chapter two, the educational inequality between rich and poor, as well as tall and short individuals is examined, putting a special focus on globalisation's role in increasing or reducing educational inequality. Furthermore, a modified Kuznets inverted U hypothesis, that is, increasing educational inequality with rising GDP p.c., is tested. While the paper focuses on Latin America for the 18th to early 20th century using a large body of new evidence on educational inequality, a broader range of countries is examined for the mid-20th century. The results show that educational inequality in Latin America increased in the "First Era of Globalisation" (1850-1913) while the contrary is true for 20th century globalisation for a broader sample of developing countries. Moreover, it is of note that large educational differences have not always existed in developing countries: the evidence shows that in

Mexico, for example, differences in educational achievement between the richer and the poorer strata of the population was modest in the 18th century but gradually increased over time. Strong evidence is found for Kuznets' inverted U hypothesis, which was on the rise during the 18th and 19th centuries in Latin America and tended to fall in the second half of the 20th century in the developing world.

In chapter three, the influence of absolute and relative deprivation – proxied by anthropometric measures – on civil war risk is examined. The study takes a long-term view, analysing civil wars from 1816 to 1999 for a global sample. Studies that assessed the relationship between average income or income inequality and civil war onset have often been limited by severe data problems for the conflict-struck and poor world regions; in particular, inequality indicators are rarely available for countries of interest (Miguel et al. 2004; Fearon and Laitin 2003). The problem of data scarcity is overcome here by using an extensive data base for inequality in well-being. The results indicate that inequality was a major trigger of civil war for the period and countries under research. The evidence for the correlation between absolute welfare levels and the probability of civil war outbreak turns out to be less clear.

Chapter two and three show that inequality is one of the main obstacles to poor countries' social and economic development. The second half of this thesis therefore focuses on certain efforts that have been undertaken by the international community to reduce inequality so far. One possibility to fight inequality and poverty in general is to provide foreign aid to developing countries. Chapter four, five and six seek to give an answer to the question whether attempts to reduce poverty and thereby inequality by providing foreign aid had positive impacts on recipients' well-being or rather produced adverse effects for the recipient country and its inhabitants.

In chapter four, the focus is put on the impacts of overall official development assistance (ODA) on recipients' well-being. Previous studies mostly used GDP per capita growth to assess whether aid has welfare-enhancing effects. However, as was already pointed out by the opening quote of this thesis, development is not only about transforming economies, but rather about transforming the lives of people. Therefore, anthropometric indicators are once again used as outcome variables. It can be shown that foreign aid had a significantly negative short-term effect on well-being in the 1960s

to late-1970s. The negative effect becomes insignificant for later periods of time. Slightly more favourable results are found when a long-term perspective is taken, indicating that it might take some time until investments in development pay off. Moreover, the results suggest that foreign aid has become more efficient over time, although positive outcomes are still counter-balanced by adverse effects.

In the two subsequent chapters, I take a more specific look at food aid. Food aid may improve the nutritional intake of the poorer strata of the population, thereby reducing inequality. This special form of foreign assistance has triggered heated debates for decades but very few empirical studies have been produced to confirm or refute the – mostly negative – presumptions about food aid's effects (Awokouse 2010; Barrett 2001; Lavy 1990; Schultz 1960). The specific impacts of food aid on malnutrition and stunting of children in recipient countries are assessed in chapter five. The results show that food aid is positively and significantly correlated with the percentage of children that are not stunted for the post-1995 period. Children's weight, which is reacting more promptly than height, is not found to be significantly affected by foreign food provisions. As a substantial literature has commented on the fact that nutritional support by different donors might have substantially different outcomes, this discussion point is also examined by taking a closer look at the two most important food aid donors: the United States and multilateral organisations. However, the impact of nutritional support on recipients' well-being does not differ significantly among donors, according to the results. To cut a long story short, while this thesis cannot give the final answer regarding the impacts of food aid on well-being, it contributes to the discussion by providing empirical results for the relationship between nutritional support and anthropometric indicators.

In chapter six, I look at the effects of food aid from a different angle: the question whether food aid has adverse effects on the recipient countries' agriculture is empirically examined. More specifically, the chapter takes a closer look at the persistent concern that food aid creates producer disincentives in recipient countries by increasing food supply and thereby lowering local food prices. Another major concern that has frequently been raised is that nutritional support might shift recipient governments' investments away from the local agriculture, thus reducing agricultural productivity. I

therefore provide an empirical assessment of whether food aid actually decreased food production in general and wheat production in particular (as wheat plays a major role with regard to in-kind food aid provisions) for a global sample from the mid-1970s to late-2000s. It turns out that I cannot support the mostly negative results put forward by prominent scholars like Schultz (1960). In fact, giving more food aid does not cause lower overall food production but is rather positively related to wheat output one year after the nutritional support was provided. Chapter seven summarises the findings and provides directions for future research.

2. Globalisation and educational inequality during the 18th to 20th centuries: Latin America in global comparison

Abstract

This paper explores inequality of numeracy and education by studying school years and numeracy of rich and poor, as well as tall and short individuals. To estimate numeracy, the age heaping method is used for the 18th to early-20th century. Testing the hypothesis that globalisation might have increased inequality of education, we find evidence that 19th century globalisation actually increased inequality in Latin America, but 20th century globalisation had positive effects by reducing educational inequality in a broader sample of developing countries. Moreover, we find strong evidence for Kuznets' inverted U hypothesis, that is, rising educational inequality with GDP per capita in the period until 1913 and the opposite after 1945.

This chapter is based on an article by Baten and Mumme (2010) and was published in the *Journal of Iberian and Latin American History*, 28(2), pp. 279-305. The concept of the paper was developed jointly, empirical analysis and writing were equally shared. In contrast to the published paper, British spelling conventions were followed in this thesis.

2.1 Introduction

Inequality is an important factor in today's globalisation of the world economy and one of the underlying causes of income inequality - educational inequality - is at the core of the debate. Educational inequality is in many cases difficult to measure because micro surveys, which are not normally comparable across countries and periods, are necessary. This contribution uses the numeracy difference between occupational groups as a measure of inequality for the period from the 18th to the early-20th century, and the difference in years of schooling between the taller and shorter half of the female population as a measure for late-20th century educational inequality. For the earlier period we concentrate on Latin America, a region where 20th century income inequality is famously high, and for the latter period we compare the countries of this region with less developed countries (LDCs) and medium-income countries elsewhere.

The relationship between globalisation and educational inequality is one of today's major issues. Is it possible that the current globalisation will fail, just as the previous globalisation tendency in the period 1850-1914 did, because inequality stimulates anti-integration forces? Timmer and Williamson (1998) found that during the 19th century, inequality in new world countries such as the USA, Brazil, Argentina, Canada and Australia provoked anti-immigration policies that led to the disintegration of Atlantic labour markets. Rising inequality could also decrease the legitimation of international integration, so that those groups which normally benefit from it (e.g. the well-educated in rich countries and world inhabitants in general) might not give it their full support.

There are other reasons why the study of educational inequality determinants is important. Firstly, inequality is now often considered as a component of the standard of living: Being at the bottom of the income distribution is much harder to bear if the distance to the wealthier part of the economy is large, and educational inequality is a determinant of later income inequality. This also applies to the inequality of schooling (Castello and Domenech 2002; Thomas et al. 2001).

Wood (1997) argued that for the 1980s and 1990s more open trade increased wage inequality in some parts of the world, particularly in Latin America (Wood 1997;

UN 1995; Cepal 2004). His studies have focused on the 1980s and 1990s. The question is whether the relationship of globalisation and inequality holds before the 1980s. In our study we are not restricted to only two decades. We are able to analyse the relationship for three centuries and will assess the difference between educational inequality in the 'First Era of Globalisation Period', as O'Rourke and Williamson (1999) defined it - namely, the 1850-1913 period - with the early phases. For a second study period, 1945-1984, we will use the openness indices of Sachs and Warner as well as trade shares to assess whether openness increased educational inequality. Inequality, though, is a complex phenomenon and many potential determinants should be taken into account as well as globalisation. We will therefore control for as many other potential determinants as possible.

Why should openness matter for educational inequality? Most research in this field has focused on income inequality in OECD countries, arguing that imports of goods mainly produced with unskilled labour could decrease the demand for unskilled labour within the rich OECD countries, depressing unskilled wages and increasing inequality. However, factor endowments and relative scarcities in developing countries (LDCs) differ fundamentally (Wood 1994, 1997, 1998).

Our expectation is that openness in fact increases inequality in countries with abundant land, and lowers inequality if unskilled labour, relative to potential trading partners, is the abundant factor. In the absence of unusual complementarities between factor inputs and other counteracting forces, poor countries will increase their exports of unskilled labour-intensive products in globalisation periods because their abundant factors and their comparative advantage are likely to be in this segment. Increasing production with unskilled labour should increase unskilled labour demand and wages, and the opposite should be true for land-rich countries. If labour demand rises (falls), even children of unskilled workers should receive some schooling (or less), although in most cases not enough to move into the upper half of income recipients.

Now, Latin America was clearly a land-rich region between the 18th and early 20th century (Prados de le Escosura 2007). Therefore, the expectation would be a rise in inequality during the 'First Era of Globalisation' (1850-1913; O'Rourke and Williamson 1999). Does the expectation also hold for the broader sample of developing

countries during the 1945-1984 period? It is somewhat less clear as some were already industrialising during the period and land became less important.

A number of scholars have studied the influence of globalisation and de-globalisation on within-country income inequality worldwide (Lindert and Williamson 2001). Bourguignon and Morrison (2000) found a strong decline of within-country inequality during the de-globalisation phase of 1914-1945, whereas within-country inequality rises during globalisation phases. Prados de la Escosura (2007) finds increasing Latin American income inequality during this period. In section 2.6, we will assess whether educational inequality also increases with growing openness.

2.2 Years of schooling, age heaping, occupations and inequality

We will first discuss the general idea of the age heaping method in this section, before discussing our measures for inequality of human capital. Age heaping is often used nowadays as a basic numeracy indicator. The share of people who are able to report their exact age rather than report a rounded age has been found to be strongly correlated with numerical abilities (Crayen and Baten 2010a). A widely-used measure for age heaping is the ABCC index, as suggested by A'Hearn et al. (2009), which divides the number of people who reported non-preferred ages (i.e., ages that are not a multiple of five) by the total number of people.[4] The index ranges from 0 to 100. If everybody reports the correct age, ABCC has a value of 100. Here, we restrict the evidence to the age groups 23-32, 33-42, 43-52 and 53-62, because ABCCs of younger and older individuals might be biased. Only units that have at least thirty cases per skill and age group are studied. The ABCC index can best be understood by considering an example. If we have 100 people with unskilled occupations of a specific age group reporting age in the census of, say, 1870, we would expect twenty of them to report an age ending in zero or five (because two of ten ages end in zero or five). For the remaining eighty individuals, the question is: do they report other ages or do they also choose an age ending in zero or five? If twenty do the latter, then one-quarter (of the eighty remaining persons) report probably a wrong age, and the ABCC is then 75 per

[4] It is called ABCC after the authors' initials and Gregory Clark who gave comments on this index.

cent (one minus one-quarter). If the people with skilled occupations in the same country and birth decade have an ABCC of 85 per cent, then the social difference of numeracy between those occupational groups is ten (85-75 per cent).[5]

It is important, however, to countercheck whether census-takers or recruitment officers did explicitly ask for the age (and did not 'correct' the reported ages afterwards). In the case of the samples studied here, we have good reasons to believe that the people were actually asked for their age, and the number of corrections made afterwards was not large. Otherwise, the relatively high level of age heaping that we observe in the data would probably not have occurred.[6]

How close is the relationship between age heaping and other human capital indicators such as literacy and schooling? A'Hearn et al. (2009) used the large U.S. census sample to perform a very detailed analysis of this relationship. They subdivided by race, gender, high and low educational status and other criteria. In each case, they obtained a statistically significant relationship. The fact that the coefficients are relatively stable between samples is also or noteworthy, i.e. a unit change in age heaping is associated with similar changes in literacy across the various tests. The correlation was both statistically and economically significant for any country studied so far that had substantial age heaping.[7]

Some uncertainty remains about whether age heaping in the sources contains information about the numeracy of the responding individual or, rather, about the diligence of the reporting personnel who wrote down the statements. A potential bias always exists if more than one person is involved in the creation of a historical source. For example, if literacy is measured by analysing the share of signatures in marriage contracts, there might have been priests who were more or less interested in obtaining

[5] This holds only if age distributions are relatively smooth. Crayen and Baten (2010a) studied the influence of famines, epidemics, wars and civil wars and found that the effect was randomly distributed and in the vast majority of cases not influential for individual age groups. The method also assumes that ages ending in zero and five are the most clearly preferred ages. This is least clear for the age group 23-32 years because heaping also frequently takes place on multiples of two. Crayen and Baten (2010a) suggest reducing the ABCC for this age group, a recommendation that we also follow.

[6] Even if the precise birthday (often related to a saint's day or a holiday) is known to the individual, it might well be the case that the exact number of years since birth means little to an individual although the annual event is celebrated again and again.

[7] On the regions of Argentina see, for example, Manzel and Baten (2009).

real signatures, as opposed to just crosses or other symbols. We find it reinforcing that we estimate generally much more age heaping (and less numeracy) for the lower social strata, and among the half of the sample population which had lower anthropometric values. Moreover, the regional differences of age heaping are similar to regional differences in illiteracy.

We conclude that the age heaping method is now a well-established indicator for numeracy of groups, but the problem regarding how upper and lower group members can be distinguished from each other for historical populations for which we typically have no individual income data remains. Occupations have often been used to classify upper- versus lower-income group individuals and we will apply this criterion to Latin American data until the 20th century (similarly to Crayen and Baten 2010b). Of course, occupations such as 'day labourer' or 'agricultural worker' typically yielded a low income, whereas professionals, noblemen, factory owners, and skilled craftsmen had higher incomes. As a caveat to this method, it should be noted that some occupations represent a wide income range (e.g. farmers).

For the study of the 1945-1984 period, we also use an alternative, similarly rough proxy to distinguish between social groups, based on human stature as Crayen and Baten (2010b) have suggested. This involves contrasting the number of years of schooling of the taller and shorter 50 per cent of the sample. Almost all anthropometric studies that considered occupational or income groupings found that the well-off strata of society were taller.[8] A second, very interesting aspect to this strategy is that tall individuals are much less likely than short individuals to have suffered from infant protein deficiency syndrome (IPDS), which reduces learning abilities to a certain extent. The syndrome was widespread during the 1945 to 1984 period in the poorest countries of the world, when malnutrition was so common that most populations were severely stunted (with adult males being shorter than 170 cm on average). Support for this claim comes from biologists and psychologists who have conducted experiments on the influence of protein malnutrition in childhood and intellectual ability later in life (Paxson and Schady 2007).

[8] For recent collections of anthropometric studies, see Steckel and Floud (1997) and Baten and Komlos (2004).

One caveat to the proposed anthropometric method is clearly that there is also genetic height variation (especially on the individual level, see Magnusson et al. 2006). Nonetheless, we are confident that most individual variation can be averaged out by means of sufficiently large sample sizes.

Why do we use such a special method to measure inequality of education? Are there no other data sets available that contain some social classification criterion (such as occupation or income), as well as educational measures for the 1945-1985 period? To the best of our knowledge, for such a large number of countries as used here (forty-two countries), consistent data sets of this type do not exist. [9]

2.3 Data sources, selectivities and representativeness

Many population counts were carried out in colonial Latin America, aiming at an overview of the population, taxpayers and the military potential. Most early counts were focused on limited regions or cities within a country. Larger censuses were carried out after the mid-18th century, covering a higher share of the national population (Table 2.1; Manzel and Baten 2010). For the post-colonial period, censuses of the republics were carried out mostly after the mid-19th century, while the early-19th century is clearly less documented. The Latin American countries currently have the best source situation of historical population enumerations among today's developing countries (Platt 1998, p.7). Our samples cover Argentina, Brazil, Colombia, Ecuador, Mexico, Uruguay and Venezuela[10] and represent therefore a large part of this world region.

[9] Another interesting measure of educational inequality was proposed by Frankema (2008) who uses a 'comparative grade enrolment distribution' to determine educational inequality. His idea is that the higher the secondary school completion shares of the attainment distribution, the larger the educational 'middle class', which might imply less educational inequality. Frankema (2008) finds that grade distribution in Latin America is skewed towards lower grades during the mid-to-late 20th century with almost 43 per cent of the pupils leaving school without passing the first grade and more than 70 per cent dropping out of school with less than 4 years of school attendance. So, despite the fact that Latin America reached almost full primary school enrolment rates, levels of school completion were very low. Unfortunately, this alternative measure is not available for the early period studied here and it is not available by birth cohort for the later period. Yet another measure of human capital inequality uses skill premia, as studied for long-term periods by van Zanden (2009). He found, for example, that less developed countries such as Indonesia and India had quite high skill premia.

[10] While borders changed during the colonial and post-colonial period, we always refer to today's borders as far as possible.

Table 2.1: Data sources for the early period

Country/Region	Year	No. Cases (age 23-62)	Potential bias relative to total population	Source
Buenos Aires, AR	1744	1,146	Urban, military, including slaves	Military Census in the *Documentos para la Historia Argentina* (Caillet-Bois 1919)
Buenos Aires, AR	1771	4,756	Urban, including slaves	Archivo Nacional de Argentina, Census 1771
Argentina	1869	43,781	No	Somoza and Lattes (1967)
Santa Fé, AR	1887	808	Regional	http://www.digitalmicrofilm.com.ar/censos/geografico.php
Argentina	1895	51,715	No	Somoza and Lattes (1967)
São Paulo, BR	1772	1,665	Household heads, servants	Arquivo Histórico Ultramarino, Cód 1270, 2096, see for a description Stolz, et al. (2013)
Floresta, BR	1859	1,283	Household heads,slaves	Arquivo Público do Estado de Pernambuco – Depositum Floresta 1859.
São Cristovão, BR	1870	456	Regional	Biblioteca do IBGE.
Colombia	1870	2,362	Various regions	Archivo Nacional de Bogotá: CE Cauca, Magdalena, Quibdo, Quindio, MF 2, 4, 6, 15,19.
West Ecuador	1870	19,109	Various regions	Archivo Nacional de Ecuador, Censo 1870
Hidalgo/Guanajuato/Oaxaca, MX	1740-43	1,383	regional	AGI: CE Ixmiquilpan 1740, Ind, 107; CE Pozos 1743, Ind, 107; CE Southern central Mexico 1743, Ind, 108; CE Chichihualtepec 1743, Ind, 108.

Table 2.1 (cont)

Central and West Mexiko	1777	3,998	Regional	AGI, Mex 2578/9.
Mexico - City , MX	1790	3,079	Capital, only Spanish and mestizo household heads	Instituto Nacional de Estadística, Geografía e Informática: CE Revillagigedo (2003).
Coahuila, MX	1823	1,598	Regional	Grupo Explaroradores Coahuiltecos
Mexico	1930	7,007	Various regions, but nationally representative	FSI: CE Guanajuato, Minas de Luz, Mineral de los Llamitos, Ahualuco, Benitez, Tepoztlán, Mezquital, Tetecala, Tlaltizapan: MF 4107114, 4107751, 4107265, 4107065.
Soriano/Maldonado	1834/36	588	Regional	Archivo Nacional de R.O. Uruguay, CE Soriano/Maldonado
Montevideo, UY	1846	1,569	Capital, prisoners	Archivo Nacional de R.O. Uruguay
Cumarebo /Quisque, VE	1818/20	1,476	Regional	AGI: Cuba 759B

Abbreviations: AGI: Archivo General de Indias; AR: Argentina; BR: Brazil; CE: Census of; FSI: Family Search Indexing Project; MF: microfilm; MX: Mexico, UY: Uruguay, VE: Venezuela. Sources: adapted from Manzel and Baten (2009), plus other sources as explained in column «source».

All in all, the countries under study represent today around 80% of the Latin American population. An important question is whether our various sources are representative of the whole society during the period under study. This issue has been studied intensively by Manzel and Baten (2010) who used mostly the same sources to study long-run trends. The population enumerations were supposed to have universal coverage in the whole area considered as well as in all social strata. Manzel and Baten have assessed many potential weaknesses of the data, such as social and regional biases. For example, one potential criticism of the padrones of the 18th century is under-enumeration. The government wanted to know the population number and age structure in order to learn about the potential of taxpayers. One could imagine that this stimulated avoidance behaviour among the richer part of the population. However, it was not easy for the rich and well-educated strata to avoid being included in the census. We find them in large numbers in our census lists, as is evident from the occupations listed.

Another potential caveat is the problem regarding who really answered the question about the age. Is it possible that perhaps only the head of the household answered for the whole house? Manzel and Baten (2010) applied an indirect method by calculating the age heaping indices for household heads and other members of the household. The expectation was that the head knew his exact age more often than the age of other household members. The difference between the two groups, however, was not very large. Other scattered evidence comes from remarks of the census officials about heads and other household members. In both cases, there were statements such as 'she did not know her age', combined with an age statement of a preferred age. This can be interpreted as evidence that other household members were also actually questioned. Ethnic composition is important for Latin America. Were Indios or slaves of African origin sometimes omitted from the padrones? The direct comparison of population structure by ethnic group given in the literature and the composition of 18th century padrones[11] revealed that the bias was limited (Manzel and Baten 2010; Table 3). In some Mexican censuses, there was some under-representation of American Indios and

[11] During the 19th century, the New Republican governments forbade statements about ethnicity.

in one of the Buenos Aires padrones there was some under-representation of African Americans, but in general the samples were quite representative in terms of ethnicity.

Regional bias is another issue that we need to address. Clearly, the early samples in particular were more often concentrated on the population of the capital (Tables 2.1 and 2.2). Large cities tend to have higher levels of inequality (Baten 1999), and hence we expect higher inequality values for the 18th century. We will assess this effect with appropriate dummy variables below.

Finally, an important point for Latin America in particular is whether migrants should be included in the individual samples. Here, we are mainly interested in the educational inequality of countries and migrants who contributed to this inequality. Therefore, we decided to include migrants as well.[12]

While the sources for the study of Latin American educational inequality during the 18th to early 20th century deserve the most scrutiny, the later 20th century evidence, which we are employing for our second study period, is easier to use. The Macro International Inc. performs surveys of child health and health-related behaviour in order to create a solid and representative database for improving child health (among other aims). They recorded years of schooling and heights of women mostly born between 1945 and 1984 in many developing countries. We included only those aged 20-50 years in many developing countries. As the height of adults is mostly determined in the three years after birth, the height of the mother can shed light on the development of status differences in this period after birth. One potential lacuna in our data is the environmental influence on growth at later ages, especially during the adolescent growth spurt. However, Baten (2000b) finds that this effect is negligible compared to the impact of the first three years, as long as individuals have reached their final height when measured. Second, there could be survivor bias effects, but Moradi and Baten (2005) and Guntupalli and Baten (2006) rejected this possibility in detailed studies.[13]

[12] See notes to Table 2.3.

[13] The data set refers mostly to mothers. Moradi (2002) explored the potential difference between mothers and non-mothers. He finds a very moderate selectivity among young mothers. Mothers at age 20-25 years were slightly less educated than the reference population. By employing usual height elasticities for education levels, Moradi estimates about 1 mm shorter height of mothers, compared with the reference population of all women aged 20-25 years. There was no significant selectivity among older women. This result suggests that selectivity of mothers might not be a major problem.

Table 2.2: ABCC indices in several Latin American countries by birth decade and occupational group

Country	Birth decade	Unskilled	Skilled	Difference
Argentina	1680	24	41	17
	1690	24	43	19
	1700	38	47	10
	1710	44	58	14
	1720	41	56	15
	1730	51	59	8
	1740	56	64	8
	1810	63	77	14
	1820	68	80	12
	1830	71	84	14
	1840	72	84	11
	1850	77	89	12
	1860	81	90	9
Brazil	1710	63	76	12
	1720	63	63	-1
	1730	60	76	16
	1740	53	67	15
	1810	72	92	20
	1820	79	88	9
	1830	70	83	13
	1840	60	82	22
Colombia	1830	56	74	17
	1840	55	65	10
Ecuador	1810	58	63	4
	1820	62	68	7
	1830	64	68	4
	1840	60	68	8
Mexico	1730	56	63	6
	1740	66	61	-5
	1750	70	70	0
	1760	70	75	5
	1880	61	78	16
		20		

Table 2.2 (cont.)

Country	Birth decade	Unskilled	Skilled	Difference
Mexiko	1890	62	85	23
	1900	72	75	4
Uruguay	1780	55	71	16
	1790	62	75	12
	1800	79	85	6
	1810	83	83	0
Venezuela	1780	55	71	16
	1790	62	75	12

Notes: «Skilled» refers to occupational groups that were skilled, or professionals. «Unskilled» refers to those with unskilled or only semi-skilled occupations.

We consider here the difference in years of schooling of the taller 50 per cent compared with the shorter half, and organise the data by individual country and birth decade.

It is remarkable that in most cases taller women had more years of schooling (Table 2.3). Small differences refer to cases such as Ghana, Madagascar or Tanzania, in which the urban centres of education differed from the regions of tallest heights, which were sometimes characterised by a specialisation in cattle farming (Moradi and Baten 2005). In Latin America, some of the strong educational inequalities by height group are partly determined by the Indio vs. European ancestor difference. It is difficult to disentangle socio-economic differences from nutritional habit differences (and perhaps genetic ones) here. Hence, we will rely on fixed effects regressions below, which control for country-specific characteristics.

2.4. Development of educational inequality

We would expect levels of educational inequality in the various countries of Latin America to be quite different because the institutional and economic structures were so varied. For example, Mesoamerica and the Andes had large shares of indigenous or mestizo populations, who received less schooling and other public goods compared with the middle and upper strata of European origin. In these regions, the

Table 2.3: Differences of school years by height (birth years 1945 – 1984)

Country	Difference of school years	School years (tall)	School years (short)	Height (tall)	Height (short)
Bangladesh	0.9	3.3	2.5	1547	1460
Burkina Faso	0.4	1.2	0.7	1663	1568
Benin	0.8	2.1	1.4	1636	1537
Bolivia	1.9	7.1	5.2	1557	1467
Brazil	1.4	6.3	4.9	1607	1508
Central African Republic	0.7	2.2	1.5	1639	1533
Ivory Coast	0.5	2.5	2	1641	1545
Cameroon	0.5	5.5	4.9	1651	1553
Colombia	1.3	7.5	6.2	1592	1496
Dominican Republic	0.9	7.3	6.5	1614	1516
Egypt	1.2	5.5	4.3	1621	1532
Ethiopia	0.3	1.7	1.4	1619	1521
Gabon	0.7	6.2	5.6	1631	1533
Ghana	0.3	4.9	4.6	1639	1541
Guinea	0.4	1.2	0.8	1638	1541
Guatemala	1.6	2.9	1.3	1518	1423
Haiti	0.9	3.5	2.6	1632	1532
India	0.9	4.2	3.3	1561	1470
Kenya	0.7	6.2	5.5	1646	1544
Kyrgyztan	0.6	11.3	10.7	1628	1538
Comoros	0.7	2.6	1.9	1592	1504
Kazakhstan	0.5	11.2	10.7	1637	1541
Morocco	1.1	3.5	2.4	1630	1539
Madagascar	0.1	3.4	3.3	1578	1487
Mali	0.5	1.2	0.8	1664	1568
Malawi	0.9	3.9	3	1607	1515
Mozambique	0.8	2.6	1.8	1609	1512
Namibia	0.7	5.4	4.7	1660	1561
Niger	0.4	0.9	0.5	1654	1560
Nigeria	1.3	5	3.7	1644	1529

Country	Difference of school years	School years (tall)	School years (short)	Height (tall)	Height (short)
Nicaragua	1.5	6	4.6	1586	1492
Peru	1.9	8	6	1549	1461
Ruanda	1	4.2	3.2	1631	1530
Senegal	0.4	1.3	0.9	1670	1574
Chad	0.5	1.3	0.7	1678	1578
Togo	0.4	1.6	1.2	1638	1542
Turkey	0.8	4.7	3.9	1600	1511
Tanzania	0.2	3.5	3.2	1606	1508
Uganda	0.5	4.6	4	1635	1534
Uzbekistan	0.4	11	10.6	1649	1553
Zambia	1	5.4	4.4	1628	1531
Zimbabwe	0.8	7	6.1	1649	1552

Notes: «Tall» is defined here as the tallest 50%, «short» as the shortest 50%. The difference in school years is the number of school years of the taller minus the shorter 50%. Female height is reported in millimetres.

inequality heritage of land distribution in favour of the Spanish conquerors and later European immigrants might have been strongest (Lambert 1968, p. 581). Similarly, strong differences might have prevailed in the countries that kept slavery until the late-19th century and whose population component of African origin was disadvantaged. In contrast, the population of the Southern Cone was more homogenous in ethnicity-related aspects, because the Indio population share was smaller and slavery was abolished earlier. However, ethnicity, slavery and colonial heritage were not the only factors at work. O'Rourke and Williamson (1999) argued convincingly that the Southern Cone countries had strongly increasing inequality during the late-19th century globalisation movement.

Going further back in time, how might inequality have differed between colonial times and post-independence Latin America? Unfortunately, today we have little evidence for the pre-independence inequality history of Latin America. Williamson (2009) and Dobado and Garcia (2009) have recently raised some doubts about the early

colonial heritage hypothesis (of continuously high inequality). Dobado and Garcia argued that real wages were quite high in some parts of Bourbon Latin America, whereas average income was lower than in Europe. Hence, inequality might actually have been lower than in Europe. The question is, of course, whether this wage evidence is representative and can inform us about the situation of other poorer strata, which did not earn wages (such as the population majority of peasants). Williamson (2009) considered the fact that especially the low population density of the 17th and early 18th centuries might have generated relatively low inequality, compared with Europe. In times of labour scarcity, wages tend to be higher and even the nutrition and general treatment of slaves and indigenous bound labour might be slightly less terrible. A recent study on Uruguay suggests that in the Southern Cone during the 18th century, inequality might also not have been very pronounced (Vicario 2010).

Economic policy differences certainly also mattered for country-specific differences. For example, the famous Mexican dictatorship era of Porfirio Díaz (1877-1911) increased average income and education, but had a reputation for bringing about sharp increases in inequality (Tutino 2001, p. 700-701). In sum, during the 19th century the variation of inequality between countries was probably large. Pre-independence inequality history is largely unexplored, but some authors have recently argued for a modest inequality level relative to Europe.

In the following, we firstly compare numeracy of the upper and lower occupational strata in Latin American countries for the early period. For Argentina, we have some data for Buenos Aires for the birth decades until 1740 and some representative national data after this date. The ABCC Index increased from 24 to 56 for the lower-income groups in Buenos Aires from the late-17th to the mid-18th centuries (Table 2.2). The upper-income groups started with a level above 40 per cent age numeracy in the 1680s, but grew to just 64 per cent in the 1740s. The fact that the early evidence on Argentina covers only Buenos Aires is certainly a caveat. The gap for the 19th century was large and relatively constant, declining only slightly from a 14 per cent difference in the 1820s to a 9 per cent difference in the 1860s.

Second, we have long-term data on Mexico covering sufficient observations to study both social groups between the 1730s and 1760s, and in the 1880s to 1900s. The

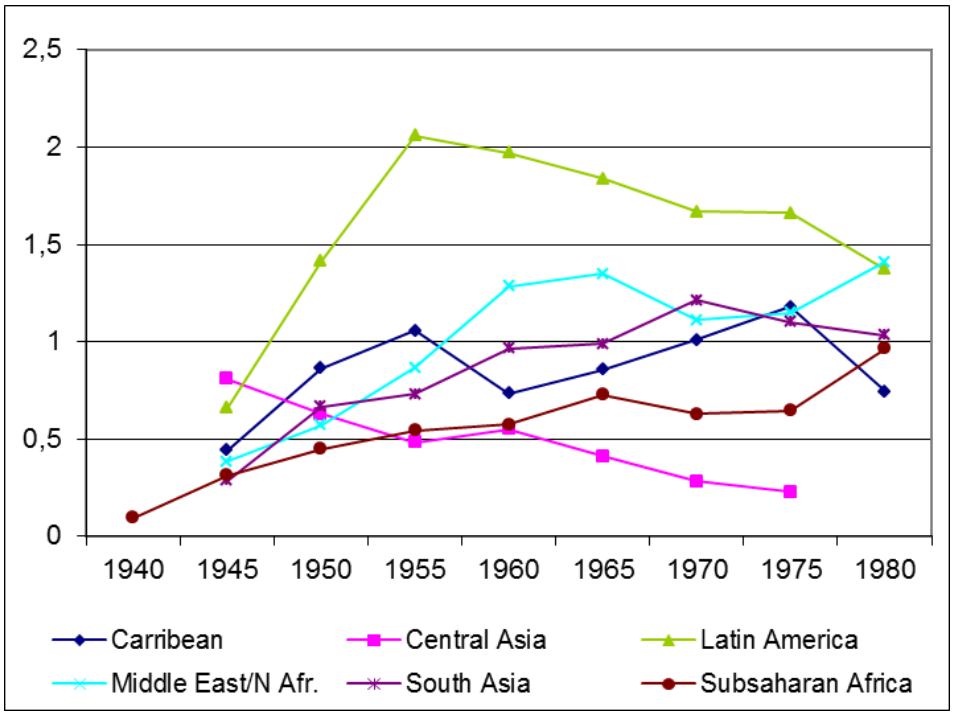
latter evidence is nationally representative, while the former relates to some Mexican regions, including Mexico City. In short, social differences in age numeracy were small and in one case even negative in 18th century Mexico. This is consistent with the observation of Tanck de Estrada (1999) that the Bourbon reforms of the 18th century had some positive impact even on school building in Indio villages, that is, for the poorest Mexicans. However, the late 19th century saw a highly stratified society with large differences. This fits with available evidence on the Porfiriato.

We have more scattered data for a number of other Latin American countries (Table 2.2). In Brazil, the highest educational inequality levels were reached in the 1840s, which are the latest values we have.[14] In Uruguay, inequality was declining, but this might have been caused by the fact that the later birth cohorts were based on data from prisons. Venezuela and Colombia had quite high inequality, whereas in poor Equador even the skilled groups had low levels of numeracy. Summing up, we can document a number of Latin American countries, but the cases for which we have sufficient numbers of observations are somewhat distributed over the different centuries. Most striking in Table 2.2 is the fact that, of the 40 cases studied, only two have negative values for the difference between the skilled and unskilled groups.

Now we move to the birth cohorts of the mid-to-late 20th century. We studied the difference of school years, subtracting the figure for the taller half from that of the shorter half (Figure 2.1). The years of schooling are a better measure for the mid-to-late 20th century than age heaping, which had already disappeared in many countries by then. It should be noted that there are many African countries in the sample, a few Latin American ones, but fewer countries from other regions. One important result from these samples is that the taller half of the population (those who probably came from more advantaged family backgrounds) always had higher or equal school year values, which tended to be lower among the shorter half of the population. Latin America had the highest difference (which means the largest educational inequality), whereas Soviet Central Asia had the lowest value (Figure 2.1).

[14] We thank Yvonne Stolz, who plans to study the Brazilian case in more detail, for providing the 18th century evidence.

Figure 2.1: School-year difference (vertical axis) in several world regions by birth years



Notes: Difference in years of schooling, value of tallest 50 per cent minus the shortest 50 per cent (women). Years refer to the beginning year of a 5-year birth cohort. Central Asia includes only the former Soviet Republics.

2.5 Openness and other potential determinants of inequality

We first describe the explanatory variables in Table 2.4 that we include in the regressions and then discuss the results.

2.5.1. Openness

How can we measure 'openness'? Given the importance of this variable, much study has been done in this field. Most economists agree that simple trade shares of GDP are insufficient by themselves to capture the degree of openness of an economy. If two neighbouring free-trade countries have exactly the same factor endowments, it is possible that their trade is relatively low in spite of their openness simply because production is so similar. On the other hand, two highly protected countries can experience high trade shares if their endowments are sufficiently different. One alternative measure is the openness index of Sachs and Warner (1995a) for seventy-nine

countries. These authors consider high tariffs, important tariff barriers, plus state monopolies of major commodity exports, a high black market premium for national currencies, and a socialist economic system. This variable is coded as a binary variable. Rodriguez and Rodrik (1999) criticised the fact that two factors in particular, the state monopoly and currency black market premium, might measure other economic characteristics rather than just a lack of openness. The currency value distortion also indicates other macroeconomic problems. However, if there is no perfect measure of openness, it is a promising strategy to use both this one and the trade share. In spite of our conceptual scepticism against the trade share of GDP as a measure of 'openness', we will also test this variable below.

2.5.2. Kuznets curve effects

Kuznets (1955) found that inequality first rises and then declines with economic development. He explained his inverted U curve by labour-market disequilibria: Since technological progress initially favours the rewards for some specialised skills, demand for unskilled labour decreases and its wage falls. Therefore, inequality rises initially. The diffusion of skills and economic policies serve as egalitarian forces which reduce inequality. We therefore add Kuznets variables by adding real GDP per worker in linear and quadratic form and expect a positive coefficient of the former and a negative effect for the latter.[15]

2.5.3 Democracy

Li et al. (1998) also emphasised the importance of political freedom for income equality. If dictatorship provides privileges to certain groups in society, this might lead to higher inequality. The research project 'POLITY IV', at the University of Maryland, created comprehensive surveys on the democratic or autocratic behaviour of

[15] Kuznets effects have recently been studied by Morrisson and Murtin (2007) for educational inequality. They construct a within-country indicator on the basis of primary, secondary, tertiary enrollment rates and confirm the existence of an educational Kuznets curve by studying this indicator for the 1870-2000 period. Kuznets curves have also been a traditional field of study for income inequality research. For example, Prados de la Escosura (2008) recently found a Kuznets curve for Spain, 1850-2000.

Table 2.4: Determinants of educational inequality

	(1)	(2)	(3)	(4)	(5)
Estimation method	FE	FE	FE	FE	FE
Birth decades	1680s-1900s	1680s-1900s	1940s-1980s	1940s-1980s	1940s-1980s
World regions	Latin America	Latin America	LDCs	LDCs	LDCs
Openness concept	Era of Globalisation	Era of Globalisation	Sachs/Warner (1995a)	Sachs/Warner (1995a)	Penn WT
Openness	7.63**	8.79**	-0.35***	-0.41**	0.01
	(0.041)	(0.042)	(0.004)	(0.04)	(0.94)
Education average	-0.12	-0.33*	0.09***	0.13	0.11***
	(0.26)	(0.059)	(0.008)	(0.19)	(0.002)
Mature	3.12	0.29		-0.01	
	(0.29)	(0.92)		(0.50)	
Civil War	0.02	-0.96	-0.17*		-0.19**
	(1.00)	(0.77)	(0.088)		(0.042)
GDP p.c.		82.16**	-0.60***	-0.47	-0.62***
		(0.012)	(0.00)	(0.59)	(0.00)
GDP p.c. squared		-43.08**	0.03**	-0.01	0.03***
		(0.011)	(0.02)	(0.95)	(0.009)

Table 2.4 (cont.)

Democracy (Polity2)			0.00	0.00	0.00
			(0.97)	(0.95)	(0.76)
Productivity lag					-0.01
					(0.12)
Constant	15.62**	-0.78	1.22***	1.54	2.06**
	(0.03)	(0.93)	(0.001)	(0.2)	(0.023)
Observations	40	40	174	63	145
R-squared	0.18	0.36	0.35	0.62	0.33

Notes: P-values in parentheses. *, **, *** refer to significance levels of 1, 5, and 10 per cent. Dependent variable in columns 1 and 2: difference in numeracy, skilled versus unskilled occupations. Dependent variable in columns 3 to 5: difference of school years, tallest 50% versus shortest 50% (calculated as the difference between the two groups). As usual with fixed effects regressions, we reported the 'R-sq within'. The models were also estimated including a prison dummy but there was almost no difference in the other coefficients. We also checked regressions with a capital city dummy, with almost no change in the other coefficients. In columns 3 to 5, we included time fixed effects. Abbreviations: FE: Fixed Effects. LDCs: less developed countries. Glob.: Globalisation. GDP per capita is expressed in units of 1000 $ (Geary Khamis $), source: Maddison (2001). Where GDP was lacking, it was linearly interpolated. Ecuador was assumed to have had the average GDP/c of Peru and Brazil. In columns 1 and 2, civil war data come from Clodfelter (2002), the share of mature was calculated from the age distributions in the censuses, see Table 2.1, and the same applies to the education average (using age heaping).

governments in recent history, approximating democracy with a numerical score.

2.5.4 Demographic effects ('mature')

Did competition reduce the wages of baby boomers? Demographic effects could have an influence on inequality. According to the normal life-cycle effect of income, people receive their highest income in their 40s and 50s. Teenagers and young adults between age 15 and 40 years earn less on average, and beyond the age of 60 years income starts to decline again. If 'fat' cohorts (e.g. the 'baby boom' generation of the 1960s) enter the labour market, we would expect a rise in inequality because the supply of 'young' labour is very large, whereas the share of the richer 'mature' age group is relatively smaller. Higgins and Williamson (1999) found a robust influence of both cohort sizes of the mature age groups. We include cohort size effects by taking the share of the mature population (aged 40-59 years), relative to the total population of the age groups 15-69 years (working age), using the same specification as Higgins and Williamson (1999).

2.5.5 Speed of structural change

How much did agricultural productivity lag? Agricultural productivity, and therefore agricultural incomes, might lag behind industry and services and this could lead to rising inequality (Baten and Fraunholz 2004).

2.5.6 Civil war

Civil war is one of the strongest determinants of welfare and educational development in developing countries. Civil war has a very destructive effect on average schooling levels, but it is less clear whether this terrible military nightmare increases or decreases the inequality of schooling. In some cases, the better-off population might be able to flee to quiet parts of the country and their children might continue attending school. On the other hand, the destruction of expected human capital returns in the future might particularly affect those strata which otherwise would have invested a lot

in the schooling of their children. Hence, it is an empirical question whether this variable increased or decreased educational inequality.[16]

2.6 Results

2.6.1 Results for the early period

All regression models are estimated as fixed effects in order to control for unobservable characteristics, such as cultural or geographic factors. In the regressions for the early period, we employed a dummy variable for the 'First Era of Globalisation' (1850-1913) as an indicator for openness. For the 18th to early 20th centuries, there is insufficient evidence to reconstruct the trade share or political protectionism, except perhaps for the last few decades of our study period (and for this period alone the number of observations would be too small). We find the regressions to have a positive coefficient of the First Era of Globalisation dummy variable (Table 2.4).

The absolute level of numeracy might reduce the inequalities in this period slightly (only significant in column 2). The 'baby boom effect' of the 'mature' variable is not visible in this period. Civil war did not have strong and significant effects on early inequality.

In the second regression, we also included GDP per capita as well as its squared term. The value of the former was large and positive while the latter had a large negative value. The former term is larger than the latter and has a greater effect on the observed values.[17] Hence, for this early period the Kuznets curve was on the rise.

2.6.2 Results for the 1945-1984 period

We compare three regression models for the later period (Table 2.4, columns 3-5). Openness actually reduced educational inequality in this period. The coefficients of Sachs and Warner openness are statistically significant, although the values of the

[16] Descriptive statistics of the explanatory variables are available in the appendix. Some variables are slightly skewed, but in most cases the skewness is only modest. Given that some of the values of the dependent variables are negative, we decided not to use a logarithmic transformation.
[17] Predicted values are available from the authors.

coefficients are not very large. In column 5 of Table 2.4, we also included an alternative measure of openness, the trade share as reported in the Penn World Tables. However, this alternative measure is not significant (after adjustment for population size, it remains insignificant).

In contrast, GDP per capita and its squared term are significant, except in column 4, which records a much smaller number of cases. The coefficient of the non-squared GDP term is much larger than the squared term. This implies that educational inequality declines with increasing income during this period. At very high levels the decline stops. The results are also quite robust over different specifications.

The level of average education increases the gap in less-developed countries, which is quite the contrary to what we might have expected. In contrast, civil war mostly reduces educational inequality - it appears that the richer strata do not send their children to school during a civil war either. Finally, there are no obvious effects of democracy, productivity lags, or the 'baby boom' effect (i.e. the 'mature' variable). The explanatory power of these models is in general quite large.

Is openness endogenous here? The question is whether the lower educational inequality of children born in a specific birth decade would cause more openness. One could imagine that - based on the general Stolper-Samuelson view - labour-abundant countries with high inequality would open their economies during a globalisation period to profit from more demand and therefore higher wages in that sector or vice versa. This might at least be the case if unskilled workers have sufficient political power. On the other hand, especially among richer countries, there might be an economic or psychological effect of higher inequality leading to less openness. Baltzer and Baten (2008) tested these hypotheses and provided evidence that low inequality in Latin American countries in the mid-to-late 20th century did not lead to more openness. Hence, we tentatively conclude that endogeneity is not a major problem here.

2.7 Conclusion

We explored inequality of numeracy and education by studying school years and numeracy of rich and poor, as well as tall and short individuals. To estimate numeracy,

the age heaping method was used. In this study, we mobilised a large body of new evidence on inequality, going back to the 18th century and covering a number of Latin American countries, namely Argentina, Brazil, Colombia, Ecuador, Mexico, Uruguay, and Venezuela. Looking at the time trend of educational inequality, Mexico displays only modest numeracy advantage for the skilled groups in the 18th century, but the gaps between the upper and lower strata increased strongly until the 19th century. Similarly, Argentina suffered substantial educational inequality during the 19th century. In a regression analysis, the "First Era of Globalisation" was mostly confirmed as having higher inequality than earlier periods.

We studied many developing countries in the period from the 1940s to the 1980s, looking at the schooling difference between the taller half of the population and the shorter half. One remarkable finding was that the taller half always had more years of schooling. This applied to forty-two different countries without exception. Latin America had the greatest educational inequality in this period, which is certainly one of the reasons for its high income inequality today.

Testing the hypothesis that globalisation might have increased inequality of education, we found evidence that 20th century globalisation had positive effects by reducing educational inequality. Moreover, we found strong evidence for Kuznets' inverted U hypothesis, which was on the rise during the 18th and 19th centuries in Latin America and tended to fall in the second half of the 20th century in the developing world.

Appendix A

Descriptives

Table A.1: Descriptive statistics, earlier sample

Variable	Obs.	Mean	Std. Dev.	Min	Max
Productivity lag (Edudiff)	40	10.15	6.62	-5.28	22.52
Openness	40	0.13	0.33	0	1
Education average (ab)	40	66.26	12.49	32.4	85.54
Mature	40	0.43	0.36	0	1
Civil War	40	0.13	0.33	0	1
GDP p.c.	40	0.84	0.41	0.36	1.88
GDP p.c. squared	40	0.86	0.91	0.13	3.53

Table A.2: Descriptive statistics, later sample

Variable	Obs.	Mean	Std. Dev.	Min	Max
edudiffabs	174	1.00	0.60	-0.15	2.58
Openness	174	1.00	0.29	0.00	1.00
GDP p.c.	174	1.60	1.30	0.35	8.93
GDP p.c. squared	174	4.19	8.69	0.12	79.78
Education average	174	6.61	3.32	1.23	14.57
Civil War	174	0.10	0.31	0.00	1.00
Democracy	174	-3.82	5.50	-9.80	9.00

Definitions and sources of explanatory variables for the later sample

Openness (Sachs/Warner): openness-dummy by Sachs and Warner (1995a), 0=closed; 1=open; The SW openness indicator is a zero-one dummy which takes the value 0 if the economy is closed according to one of the following criteria:

1. average tariff rates = higher than 40%
2. barriers cover on average more than 40% of imports
3. socialist economic system
4. state monopoly of major exports
5. black market premium higher than 20% during the 1970s or 1980s

Source: http://www.nuff.ox.ac.uk/Economics/Growth/datasets/sachs/sachs.htm

Openness 'Penn WT' (M+X/Y): The trade share of GDP, unadjusted or adjusted for population size, with the regression given in Gylfason 1999.
Source: Heston and Summers: Penn World Tables 5.6, http://datacentre2.chass.utoronto.ca/pwt/

*Productivity lag***:** productivity ratio of industry and services to agriculture = Real GDP per worker in industry and services / Real GDP per worker in agriculture; calculated on basis of 'Agriculture value added per Worker, constant 1995 USD' (Source: 1999 World Development Indicators CD-ROM), 'Labor Force in agriculture, % of total' (Source: 1999 World Development Indicators CD-ROM), 'Real GDP per Worker, 1985 international prices'
Source: Heston and Summers: Penn World Tables 5.6, http://datacentre2.chass.utoronto.ca/pwt/

Polity 2: democracy score, -10 (=autocratic) to 10 (=very democratic)
Source: Marshall and Jaggers: Polity IV-data set; http://www.bsos.umd.edu/cidcm/inscr/polity

Civil war: this variable is coded as a dichotomous variable adopting the value 1 if civil war broke out in five-year period. It is defined as sustained combat between the armed forces of a government and forces of another entity for central control or for local issues. 1,000 battle-related deaths per year. Military and civilian deaths are counted. Sources: Correlates of War Project and Uppsala Conflict Data Project. We recorded all civil wars matching these criteria mentioned in Clodfelter (2002).

GDP p.c.: Real GDP per Worker, 1990 international prices

Sources: Maddison (2001), see also Alan Heston and Robert Summers: Penn World Tables 5.6, http://datacentre2.chass.utoronto.ca/pwt/

GDP p.c. squared: Real GDP per Worker, squared

Source: see above.

Mature: proportion of the adult population 15-69 who are 40-59 old, a measure of cohort size effects.

Source: U.S. Census Bureau: International Data Base (IDB); http://www.census.gov/ipc/www/idbnew.html; The Latin American data were adapted from Baten and Fraunholz (2004).

Data Sources

Sources for Argentina

We were able to use a large number of primary sources on the development of numeracy in Argentina, the earliest source being the military census of 1744 for Buenos Aires reproduced in the *Documentos para la Historia Argentina* (Caillet-Bois 1919). The early data for the capital were completed by the census of Buenos Aires for 1771. Later information on the capital is provided by the census of Santa Fé 1887. Moreover, we can incorporate into our analysis the samples of the first two national population censuses of the years 1869 and 1895 that contain extensive information on a representative sample of the Argentinean population and were collected by Somoza and Lattes (1967).

Sources for Brazil

The Brazilian sample consists of early surviving censuses for a number of places in the regions of São Paulo, Floresta (a city in the province of Pernambuco), and São Cristovão (in the province of Rio de Janeiro). We might expect the latter data to be slightly biased as São Cristovão was populated by rather rich people.

Sources for Ecuador

In the case of Ecuador, we could include the western provinces of the country based on the census of 1870. Unfortunately, evidence for the Amazonas region did not survive. We thank Dacil-Tania Juif and Heike Schmutz for their data collection work.

Sources for Mexico

The *Archivo General de Indias* in Seville offers a considerable amount of primary sources for Mexico. For 1740-1743, population enumerations for Hidalgo, Guadalajara, and Oaxaca are included in our sample. For 1777, age data for Mexico City, Durango, Chihuahua, Baja California, Oaxaca, Puebla, and Veracruz are available. We also use a sample on the capital from the *Censo de Revillagigedo* carried out

between 1790 and 1794 in Mexico. This was the first enumeration to use a standard format for listing the population by name, age, sex, and family status. Not all census forms have survived but those remaining still provide information on 15 quarters of Mexico City.

For the later period, data from various places in Mexico are available for the year 1930, which were taken to create a nationally representative sample of the country.

Sources for Uruguay

The National Archive in Montevideo offers interesting sources on the development of numeracy in Uruguay: the prison records (1846), the census of Soriano (1834), and the census of Maldonado (1836) that we used in this paper.

Sources for Colombia

The Colombian census data originates from the National Archive in Bogotá. For the 19th century, the census of 1870 offers information on Cauca, Magdalena, Chocó, Quindio, and other departments. The great variety of Colombian provinces in our data enables us to analyse the development of basic numerical abilities in Colombia comprehensively.

Sources for Venezuela

The evidence on Venezuela comes from the Archivo General de Indias. We thank Christina Jedermann and Gerrit Ulrichs for their help. The data contains 1,476 observations about age, occupation and sex of the individuals.

Methodology and basic concepts of age heaping

We study numerical abilities in this article, which are an important component of overall human capital. In order to provide estimates of very basic components of numeracy, we apply the age heaping methodology.[18] The idea is that in less developed countries in the past, only a certain share of the population was able to report their own age exactly when census-takers, army recruitment officers or prison officials asked for it. The remaining population reported a rounded age, for example, 40, when they were in fact 39 or 41. In today's world of obligatory schooling, passports, universities, birth documents, and bureaucracy, it is hard to imagine that people did not know their exact age. But in early and less organised societies this was clearly different. The typical result is an age distribution with spikes at ages ending in a five or a zero and an underrepresentation of other ages, which does not reflect the true age distribution. There was also some heaping on multiples of two, which was quite widespread among children and teenagers and to a lesser extent among young adults in their twenties. This shows that most individuals actually knew their age as teenagers, but only in well-educated societies were they able to remember or calculate their exact age again later in life.[19]

To give an example of rounding on multiples of five, the census of Mexico City 1790 reports 410 people aged 40, but only 42 aged 41. This was clearly caused by age heaping. Apolant (1975, p. 333) gives individual examples of age misreporting: Joseph Milan, who appeared in February 1747 as a witness in a Uruguayan court should have been 48 years old, according to one judicial record. However, in the same year, but in another judicial record, he declared his age to be '45 years'. Demographers see this age misreporting as a problem when calculating life expectancies and other population statistics. However, it is precisely this misreporting that enables us to approximate numerical abilities of historical populations. The ratio between the preferred ages and the others can be calculated by using several indices, one of them being the Whipple

[18] For more detailed surveys on the age heaping methodology see A'Hearn et al. (2009).
[19] At higher ages this heaping pattern is mostly negligible, but interestingly somewhat stronger among populations who are numerate enough not to round on multiples of five.

index.[20] To calculate the Whipple index of age heaping, the number of people reporting a rounded age ending with 0 or 5 is divided by the total number of people and this is subsequently multiplied by 500. Thus, the index measures the proportion of people who state an age ending in a five or zero, assuming that each terminal digit should appear with the same frequency in the 'true' age distribution.[21]

$$(1)\ Wh = \left(\frac{\sum (Age25 + Age30 + ...Age60)}{1/5 \times \sum Age23 + Age24 + Age25 + .. + Age62)} \right) \times 100$$

For an easier interpretation, A'Hearn et al. (2009) suggested another index, which we call the ABCC index.[22] It is a simple linear transformation of the Whipple index and yields an estimate of the share of individuals who correctly report their age:

$$(2)\ ABCC = \left(1 - \frac{(Wh - 100)}{400}\right) \times 100 \text{ if } Wh \geq 100 \text{; else } ABCC = 100 .$$

The share of people able to report an exact age turns out to be highly correlated with other measures of human capital, like literacy and schooling, both across countries, individuals and over time (Bachi 1951, Myers 1954, Mokyr 1983, A'Hearn et al. 2009). A'Hearn et al. (2009) found that the relationship between illiteracy and age heaping for less developed countries (LDCs) after 1950 is very close. They calculated age heaping and illiteracy for not less than 270,000 individuals who were organised by 416 regions, ranging from Latin America to Oceania.[23] The correlation coefficient with illiteracy was as high as 0.7. The correlation with the PISA results for numerical skills was even as high as 0.85, hence the Whipple index is more strongly correlated with numerical skills. They also used a large U.S. census sample to perform a very detailed analysis of this relationship. They subdivided by race, gender, high and low educational status and other

[20] A'Hearn, Baten and Crayen (2009) found that this index is the only one that fulfils the desired properties of scale independence (a linear response to the degree of heaping), and that it ranks samples with different degrees of heaping reliably.

[21] A value of 500 means an age distribution with ages ending only on multiples of five, whereas 100 indicates no heaping patterns on multiples of five, that is exactly 20 per cent of the population reported an age ending in a multiple of five.

[22] The name results from the initials of the authors' last names plus Greg Clark's, who suggested this in a comment on their paper. Whipple indexes below 100 are normally caused by random variation of birth rates in the 20th century rich countries. They are not carrying important information, hence normally set to 100 in the ABCC index.

[23] See A'Hearn et al. (2009), appendix available from the authors.

criteria. In each case, they obtained a statistically significant relationship. The fact that the coefficients are relatively stable between samples, i.e., a unit change in age heaping is associated with similar changes in literacy across the various tests, is also remarkable. The results are not only valid for the U.S and in any country with substantial age heaping that has been studied so far, the correlation was both statistically and economically significant.

In order to assess the robustness of those U.S. census results and the similar conclusions drawn from late-20th century LDCs, A'Hearn et al. (2009) also assessed age heaping and literacy in 16 European countries between the Middle Ages and the early-19th century. Again, they found a positive correlation between age heaping and literacy, although the relationship was somewhat weaker than for the 19th or 20th century data. It is likely that the unavoidable measurement error when using early-modern data caused the lower statistical significance.

Age heaping has also been compared to other human capital indicators, for example primary schooling rates. The widest geographical sample studied so far was created by Crayen and Baten (2010a), who were able to include 70 countries for which both age heaping and schooling data (as well as other explanatory variables) were available. They found that primary schooling and age heaping were closely correlated in a series of cross-sections between the 1880s and 1940s, with R-squares between 0.55 and 0.76 (including other control variables; see below). Again, the coefficients were relatively stable over time. This large sample also allowed the examination of various other potential determinants of age heaping. To assess whether the degree of bureaucracy, birth registration, and government interaction with citizens is likely to influence the knowledge of one's exact age, independently of personal education, the authors used the number of censuses performed for each individual country for the period under study as an explanatory variable for their age heaping measure. Except for countries with a very long history of census-taking, all variations of this variable turned out to be insignificant, which would suggest that an independent bureaucracy effect was rather weak. In other words, it is sometimes the case that societies with a high number of censuses had high age awareness. But, at the same time, these societies were also early in introducing schooling and this variable clearly had more explanatory power in a

joint regression than the independent bureaucracy effect. Crayen and Baten also tested whether the general standard of living had an influence on age heaping tendencies (using height as well as GDP per capita to serve as a proxy for welfare) and found a varying influence: in some decades there was a statistically significant correlation, but in others this was not the case. Cultural determinants of age heaping were also observable, but their strongest influence was visible in East Asia, not in the Latin American countries under study in this article.

In this article, we employ the ABCC measure of age heaping, computing indexes for different countries and birth decades. In order to do so, we use the age groups 23-32, 33-42, etc.[24] The age range from 63 to 72 was omitted as this age group offers too few observations, especially for the 17th and 18th centuries when mortality was relatively high.[25]

An advantage of the age heaping methodology is that age statements are more widely available than other human capital proxies like signature ability or school attendance. As Reis (2008) argues, the age heaping measure is a very basic measure of human capital. It is, therefore, especially valid to study human capital development in Latin America in the 17th and 18th centuries when more advanced human capital indicators were quite scarce and reflected only the skills of the elite.

[24] An advantage of this method is to spread the preferred ages, such as 25 or 30, more evenly within the age groups and it also adjusts for the fact that more people will be alive at age 50 than at age 54 or at age 55 than at age 59 (Crayen and Baten 2010a).

[25] Given that young adults aged 23 to 32 round partly on multiples of two rather than five, we use the adjustment method suggested by Crayen and Baten (2010a) to increase the Whipple value (minus 100) by 24 per cent before calculating the ABCC measure.

3. Does inequality lead to civil wars? A global long-term study using anthropometric indicators (1816-1999).

Abstract

We test for the influence of absolute and relative deprivation – proxied by anthropometric methods – on civil war risk. A comprehensive height data set allows us to go back to 1816 for a global sample. We measure absolute deprivation using human stature and we use height inequality within birth cohorts to measure relative deprivation. We take care that selectivity caused by missing values does not bias the results. We find that relative economic deprivation within populations (i.e., inequality) had a strong and consistent impact on the propensity to start civil wars. By contrast, absolute deprivation was significant in most but not all specifications. We also attend to potential endogeneity through instrumental variables.

This chapter is based on the paper by Baten and Mumme (2013) and was published in the *European Journal of Political Economy*, 3*2*, pp. 56-79. The concept of the paper was developed jointly, empirical analysis and writing were equally shared. In contrast to the published paper, British spelling conventions were followed in this thesis.

3.1. Introduction and literature overview

Despite an extensive literature and the existence of a journal dedicated to the study of civil war, there have been no definitive conclusions about the reasons for civil war.[26] Paul Collier and Anke Hoeffler (2004, 2009) ask whether civil wars can be explained best by 'grievance' such as inequality or a lack of political rights, or by 'greed'. The latter can entail control over natural resources or control over government in general to extract rents from the population. Arnson (2005) states that, although resources are central to the duration and intensity of war, the roots and objectives of war can be explained best by grievances. The factors that have been commonly found to underlie civil war are poverty, ethnic or religious discrimination, lack of democracy, and opportunities for rebellion (Collier and Hoeffler 2004).

We focus on inequality as the determinant of the onset of civil war. Early theoretical studies often consisted of consideration of the appropriate functional form for the relationship between inequality and the onset of civil war. See for example Muller (1985), Davis (1954), Havrilesky (1980), Parvin (1973), Nagel (1974), and the review by Lichbach (1989). The studies that have assessed the relationship between inequality and civil war empirically (see for example Alesina and Perotti 1996; Cramer 2003; Muller and Seligson 1987, among others) have reported both positive and negative findings.[27]

Some authors admit that the empirical results are compromised by severe data problems for the poor and conflict-prone regions in the world. Only incomplete or imprecise estimates of GDP per capita or Gini indices are in general available for countries affected by civil war. Miguel et al. (2004) conclude that, as a result of lack of reliable data on income inequality, especially with respect to African countries, it is not possible to assess the relation between income inequality and onset of civil war. Fearon and Laitin (2003) state: "The poor quality of the inequality data, available for only 108

[26] Relevant studies include Sambanis (2001), de Soysa (2002), Collier and Hoeffler (2004), Ross (2004), Collier and Sambanis (Eds.) (2005), Ron (2005), Lujala et al. (2005), Fearon (2005), Montalvo and Reynal-Querol (2005), Blattmann and Miguel (2010), World Bank (2011), etc.

[27] Thaize Challier (2010) analysed the whether greater social distance was positively related to socio-political conflicts in France between the 11th and 14th century, but did not find a clear impact.

countries, does not allow us to go beyond the claim that there appears to be no powerful cross-national relationship between inequality and onset (…)."

By using a comprehensive data set, we are able to overcome the data problems that have hindered other studies. We hypothesize that populations in which people feel deprived compared to others are more likely to start a civil war and we also propose a positive relationship between absolute deprivation and increased risk of civil war. The absolute deprivation therefore depicts the average level of poverty or well-being within a population, while relative deprivation is defined here as inequality measured by anthropometric indicators. The novelty of our study is that we do not define poverty or inequality in monetary terms but take an approach that is close to Amartya Sen's capability-emphasising approach to human well-being.[28] Martha Nussbaum, who refined the approach by developing a list of the most fundamental capabilities a society should have, proposes health – defined as "being able to have good health, including reproductive health; to be adequately nourished; to have adequate shelter" – as one of the central human capabilities (Nussbaum 2003). Our proxies for well-being and inequality – average height and the inequality thereof – are determined to a large extent by this capability.[29] While recent studies limit their scope to the time period since World War II or even the post-Cold War period, our method allows us to investigate a much longer period. We assess civil wars from 1816 onwards, amounting to 306 conflicts. We also take into account potential endogeneity issues, a problem that has been ignored in many earlier empirical studies.

The rest of the paper is organised as follows. Section 3.2 presents our data and introduces our proxy for absolute and relative deprivation as well as the subsequent hypotheses. Section 3.3 presents the estimation framework and results. Section 3.4 concludes.

[28] Capabilities in Amartya Sen's approach are opportunities that depend on peoples' personal and social circumstances.

[29] Of course, bodily health is also positively related to monetary wealth as richer people have better access to food and health services.

3.2. Data, methods and hypotheses

Because of the extended time period covered, we use an enlarged version of the Correlates of War (COW) project's data[30] on intrastate wars, beginning in 1816.[31] The onset of civil war is coded as a dichotomous variable adopting the value 1 if at least one new civil war started in a given country during a ten-year period. The COW database only contains information on those conflicts that caused at least 1,000 battle-related deaths (of all participants) per conflict year.[32] Furthermore, a civil war is only included in the data set if one of the conflict parties is the government of a state[33] and both sides are organised armed forces, capable of "effective resistance".[34] As the COW database excludes colonies, we apply the same definition to Clodfelter's compilation of civil wars (Clodfelter 2002) and hence obtain global coverage, as far as historical sources commented on such large-scale civil war events.

Economic deprivation has often been mentioned as one of the major determinants of civil conflict, but so far it has always been measured in terms of purchasing power in the literature. Moreover, it has never been possible to assess this factor over two centuries. Instead of using GDP per capita, we introduce adult male height as an indicator of the biological components of well-being, with low heights functioning as a proxy for absolute deprivation.[35] There is comprehensive anthropometric theory documented in the literature that cannot be reported here in detail

[30] Cf. Sarkees (2000).
[31] For further information, see Singer, and Small (1972), or: http://www.correlatesofwar.org.
[32] In order to be considered a war participant, a state has to contribute at least 1,000 troops or suffer 100 battle-related deaths while the war participant non-state group is already considered a war participant if it commits 100 armed people or suffers 25 deaths.
[33] This criterion differentiates classical intrastate conflicts from so-called 'New Wars' in which the government does not have to be involved (see Münkler 2003; Chojnaki 2005). Please note that according to the new definitions of the COW project, war types 6 and 7, Regional internal and intercommunal wars, are also considered to be intra-state wars, but no civil wars. Civil wars are either Civil wars for central control (type 4) or Civil wars over local issues (type 5).
[34] Effective resistance means that either "(a) both sides had to be initially organised for violent conflict and prepared to resist the attacks of their antagonists, or (b) the weaker side, although initially unprepared, is able to inflict upon the stronger opponents at least five per cent of the number of fatalities it sustains." The definition of wars is explained in the Intra-State war Codebook, available at http://www.correlatesofwar.org/COW2%20Data/WarData_NEW/WarList_NEW.html (last access, January 16th, 2013).
[35] For collections of recent examples, see Komlos and Baten (1998a), Steckel and Floud (1997), and Komlos and Cuff (1998). On height inequality research, see Soltow (1992) and Quiroga and Coll (2000).

(Komlos 1985; Steckel 1995; Baten 2000b; and on height inequality especially Baten 2000a). These studies provide proof that genetic factors matter strongly at the individual level, while population averages are mostly determined by nutrition and health conditions. If a person's parents were tall, he or she is also tall for genetic reasons, but, at a population level, the Dutch were very short during a period of severe protein malnutrition during the mid-19th century, for example. Many patterns that earlier anthropologists considered to be attributable to genetics (such as tall Masai and Tutsi) turned out to be the results of special nutritional and health environment features.

Information on adult male height was obtained from Baten and Blum (2012) who collected a very large number of height estimates, comprising 165 countries and all world regions since 1810.[36] If the average height of people (that are adults at the time of measurement) that were born during a certain decade is relatively low (high) compared to individuals born during other decades, we know that there is a high probability that malnutrition and a bad (good) health environment prevailed during the birth decade.[37] The influence of the environment on an individual is strongest during the first three years after birth (Eveleth and Tanner 1990; Baten 2000a).[38] Hence the existing height

[36] To be more precise, we have data on average heights of adults and we know their exact time of birth. On the basis of this information, we estimate the decade in which the individuals were born. Baten and Blum obtained the data on the basis of a very large range of available height estimates, plus the Measure DHS (Demographic and Health Surveys) project data (http://www.measuredhs.com/), where available, plus estimates using the World Health Organisation's (WHO) Global Database on Child Growth and Malnutrition (http://www.who.int/gdgm/p-child_pdf/). Stature measurements of adults that were recorded decades later can be used to shed light on the period of the first years after birth (Fogel 1982, 1986; Steckel 2009; Komlos 1985; Moradi and Baten 2005). In late 20th century, there may be a modest effect of intergenerational height transmission at a population level in wealthy populations due to nutritional customs (for example, in Japan; Baten 2006). The nutrition and health impact on height is confirmed by studies such as the one by J.P. Habicht et al. (1974), who found that upper class groups of African countries were of similar height as the average U.S. citizen, whereas the middle and lower class in these countries were severely stunted. Correspondingly, educated young Chinese in Beijing today are only marginally shorter than the U.S. standard would predict. There may be exceptions with very isolated populations, such as the Pygmies, for whom genetic height potential may play a limiting role at the population level. In other words, for those populations even optimal diet and health conditions would not produce height levels similar to Western averages. But those exceptional populations have never accounted for a substantial share of the world population during the past two centuries.

[37] For example, we have data on a large number of people who are now adults (and therefore full-grown) and were born in the 1960s and 1970s. If the average height of people that were born during the 1970s is relatively low compared to those born in the 1960s, we can assume that living conditions were worse in the 1970s and that these living conditions hampered the growth of people born during this decade.

[38] The height data points and their limitations are documented in detail there. Following Baten and Blum (2012), we use estimates that were transformed into male equivalents, since the vast majority of historical

evidence is aggregated by country and birth decade. The countries and birth decades covered are shown in Table B1.

One could imagine the potential problem that heights were measured in a selection of countries, for example, countries with a long tradition of measurement and academic study. This could cause sample selection bias due to missing values for the other countries. Fortunately, our data coverage of poor world regions is very comprehensive. Still, we take care that selectivity caused by missing values does not bias the results. Sources and detailed explanations of other explanatory variables than the main variables described above can be found in the appendix.

Malnutrition has been previously assessed in the literature as a potential cause of conflict, uprisings, and civil wars. Grain price shocks, for example, were often associated with periods of malnutrition. Increasing grain prices as a determinant of conflicts turned out to be particularly important for research on the French Revolution and the conflicts of 1830 and 1848 that occurred after seasons of unusually bad harvests (Labrousse 1948). Marie Antoinette's recommendation to eat cake when bread was lacking was hardly of advantage to the starving population. Similarly, Berger and Spoerer (2001) found that in the European case "it was economic misery, rather than 'ideas' that caused the outbreak of revolutions in early 1848." More recently, Moradi (2005) studied the effect of malnutrition on the probability of civil war in African regions. He found that an increase in calories per day from 1800 to 2500 reduced the risk of civil war outbreak by 11 per cent. These examples suggest that internal armed conflicts typically break out one or more years after a famine. Lags in estimating the effect of anthropometric deprivation on civil war occurrence should therefore be taken into account. Following findings in prior literature, we assume that a civil war is less likely to occur if people are economically well-off and therefore hypothesise:

Hypothesis 1: *The higher the extent of absolute deprivation in a country during the decade prior to the time of observation, the more likely a civil war is to break out in that country.*

height estimates are for males. For further discussion of the topic and advantages of this method, see Baten and Blum (2010), pp. 8.

Adverse living conditions lead to dissatisfaction of the society, which might at a certain point result in the onset of a conflict. It is important to keep in mind that it would not be the individuals whose height we are using that would lead the revolt as these are still children at that point in time. The measured individuals merely shed light on the living conditions during the years after their time of birth (and they share these living conditions with adults at the same time who might start a civil war).

Of course, discontent does not always lead to violent conflict. But *if* conflict results from discontent, it generally takes some time until the dissatisfaction is great enough to result in the onset of civil war. We therefore look at the living conditions in the decade *prior* to the onset of a civil war. Aggregation to time periods – unavoidable due to the availability of evidence – is common in the civil war literature[39] as it might also remove some of the random noise.

Despite our expectation that there is a negative relationship between well-being and onset of civil war, it might also be the case that it is not absolute deprivation of an entire society that makes people engage in conflict but rather relative deprivation. Nafziger and Auvinen (1997) argue that conflict is likely to occur if people feel disadvantaged relative to others. Moreover, some parts of the population might feel especially deprived if they observe different consumption patterns of the richer strata even if severe deprivation in absolute terms does not exist (Nafziger and Auvinen 1997). Barron et al. (2004) show that there is a significant and positive relationship between (income) inequality and conflict in Indonesia, especially on the village level. Furthermore, recruiting activities might be most successful in regions with high inequality, as Macours (2011) shows for Nepal between 1996 and 2006.

As a second main methodological contribution, we assess relative deprivation measured by the coefficient of height variation. This variable measures how unequal the access to good nutrition and healthcare is for different social groups in society. We use the coefficient of height variation (CV from here) to estimate height inequality – and thereby the inequality of living standards – of a population within a designated birth decade. The coefficient of height variation is a good proxy for income inequality, as

[39] Most of the other studies use 5-year-periods, see for example Collier and Hoeffler (2004), Collier et al. (2009).

Table 3.1: Regressions of the relationships between (a) height inequality and (b) average height and GDP/c.

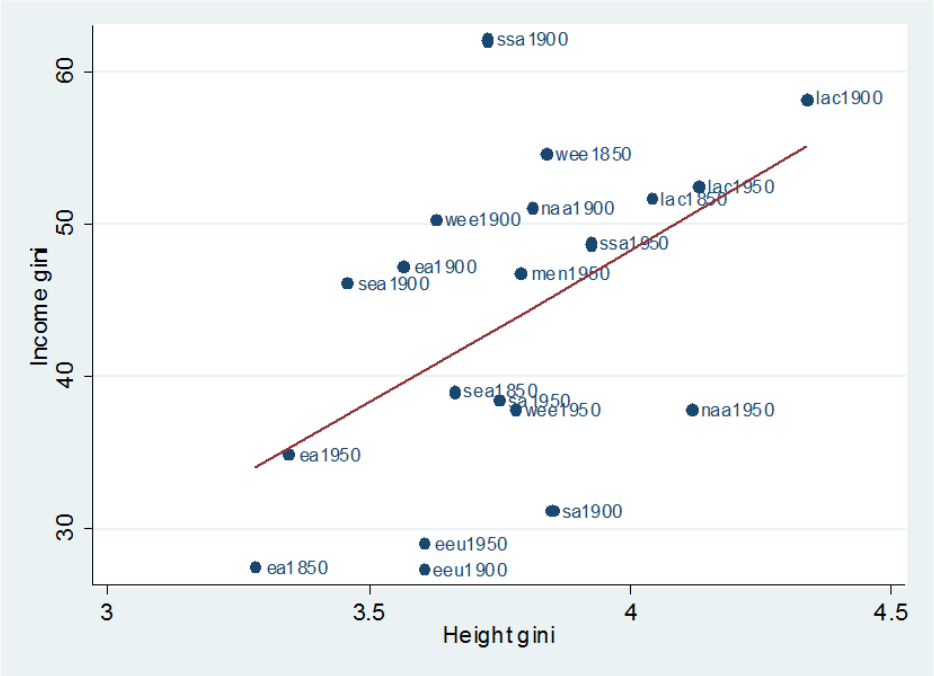
Model (1) – Source: van Zanden et al. (2014), Table 3, Appendix A. Model (2) – Source: Moradi and Baten (2005), Table 2, Column 2. Data sources of their study: Demographic and Health Surveys. The income Gini coefficients were derived from twelve primary sources listed in Deininger and Squire (1996). Models (3) and (4) – Source: Baten and Blum (2012).

	(1)	(2)	(3)	(4)
Dependent variable:	Gini coefficient of income inequality	Gini coefficient of income inequality	GDP/c (log)	GDP/c (log)
Height inequality	10.46***	20.93***		
Height			0.105***	0.143***
Significance	p-value	t-stat.	p-value	p-value
	-0.006	2.87	0	0
Geography	World	Africa	World	World
Period	1820-2000	1950-1980	1870-1949	1950-1989
Observations	129	78		
Adj*. R^2	0.26	0.44	0.47	0.44

Note: *** refers to 1% of significance level. Height inequality is the coefficient of variation (CV) of height, while average height refers to height in cm, both organised by country and birth decade. The R^2 in model (2) is adjusted, whereas the ones in the other columns are unadjusted. Model (1) - Source: van Zanden et al. (2014), Table 3, appendix. The coefficient of height inequality of the World includes decade fixed effects. Estimates are weighted-least-squares (weights: population sizes). The authors further subdivided into an early and late sample, and the correlation between height and income inequality remained robust. Model (2) – Source: Moradi and Baten (2005), Table 2, Column 2. The regressions include fixed effects for population coverage and income definition. Data sources of their study: Demographic and Health Surveys. The population definition fixed effects differentiate between inequality referring to households, total economically active population, all income recipients and taxpayers, with the income definitions referring to expenditure, net income and income not nearer specified. The income gini coefficients were derived from twelve primary sources listed in Deininger and Squire (1996). Model (3) and (4) – Source: Baten and Blum (2012). For model (4), the authors excluded Japan and Guatemala (height sources refers to Indios only). Model (3) includes all countries, also Japan and Guatemala. The authors assessed the effect of outliers such as Japan in further regressions and found them not to influence the overall relationship.

shown in Table 3.1 and Figure 3.1. In Table 3.1, we summarise previous results (Baten 2000a; Moradi and Baten 2005; Van Zanden et al. 2014) on the relationship between income and height inequality, as well as on the relationship between GDP per capita and average height. Independent of geographic and temporal scope, earlier studies found a relatively close – given that all inequality statistics contain measurement error – and significant correlation. This holds similarly for the relationship between average height and GDP per capita (models 3 and 4 in Table 3.1). To obtain a graphical impression, we aggregated the inequality evidence by world region and half century units of birth (Figure 3.1).

Figure 3.1. The relationship between height inequality and income inequality by world region and half century



Notes: The abbreviations refer to the world region and the half century (start year is given). Abbreviations of world regions: ea = East Asia; eeu = Eastern Europe; lac = Latin America and Caribbean; men = Middle East/North Africa; naa = North America, Australia, New Zealand; wee = Western Europe; sa = South Asia; sea = Southeast Asia; ssa = Sub-Saharan Africa; birth half centuries from 1850s are included. Source for income gini coefficients: van Zanden et al. 2014. See their appendix also on the linear transformation of height CV into height "ginis". The correlation coefficient between the two variables above is 0.51 (p=0.023).

As a result, Latin America during the early 19th century displays both high income and height inequality, and East Asia and Eastern Europe had low values for both inequality indicators. One deviation from the regression line was Sub-Saharan Africa during the early 20th century, but this was most likely due to measurement error as there is little informative evidence on income inequality in Africa before the 1980s.[40] The overall correlation between the two measures was – even including early 20th century Africa – 0.51 (p-value 0.023). Obviously, the correlation between the two measures is not a perfect one. Measurement error is always a possibility, especially in inequality measures. In addition, human height is influenced by public goods, such as the healthcare system within the society. We argue that anthropometric inequality measures can be advantageous compared to income-based inequality indicators in civil war studies as height captures important aspects of living standards, in particular nutrition and health (Komlos 1985; Steckel 1995). More specifically, although income inequality is an important factor for dissatisfaction, people might be even more inclined to rebel if they feel deprived of very basic factors of well-being while other groups of the society have access to these. We therefore hypothesise:

Hypothesis 2: *Higher inequality within a country, measured by the coefficient of height variation, leads to a higher probability of the onset of civil war.*

We calculate the coefficient of height variation on the basis of our height data. For a country i and birth decade t, the CV is defined as:

$$CV_{it} = \frac{\sigma_{it}}{\mu_{it}} \cdot 100$$

A high coefficient of height variation therefore implies that a society is highly unequal.

[40] Interestingly, Western Europe moved from high income- and height inequality during the late 19th century to lower inequality levels during the early 20th century (i.e. when the welfare state was introduced).

3.3 Estimation framework and results

We analyse the probability of the onset of civil war within a ten-year period in a country from the 1810s to 1990s. Our basic model is a logit regression of the form

$$Civil\ War_{it} = \beta_0 + \beta_1\, height_{i,t-1} + \beta_2\, inequality_{i,t-1} + BX + \eta_i + \gamma_t + \varepsilon_{it}$$

where t refers to a decade, and i refers to the country in question. X is the vector of control variables, while γ_t denotes time fixed effects that have been added to control for unobserved factors. Geographic fixed effects η_i are controlled for with world region dummies or country fixed effects estimation. We use clustered standard errors to avoid potential consequences of serial correlation.[41]

Civil War is an indicator that equals one if a new civil war started in country i during decade t and equals zero otherwise, so we only look at the determinants of the onset of war, not ongoing wars. We are lagging height and inequality levels in all but the instrumental variables specifications to avoid contemporaneous correlation, because heights as well as inequality might be influenced by civil wars. Civil wars are likely to increase absolute deprivation by destroying infrastructure and harvests and therefore complicating access to food and healthcare. Inequality might rise for the same reasons mentioned above, especially because already poor people will have less access to scarce resources. Moreover, one could imagine that the poorer sections of society that have neither political nor economic power will be disproportionally burdened with the costs of reconstruction and other costs that incurred during and after the war. On the other hand, it is also possible that inequality is reduced if the assets of richer people are heavily affected by civil war and the society therefore becomes relatively more equal.

Apart from our key variables that are proxies for absolute and relative deprivation, there are several other variables that might be potential determinants of civil war and that were included in our models.[42] As these variables are usual controls in

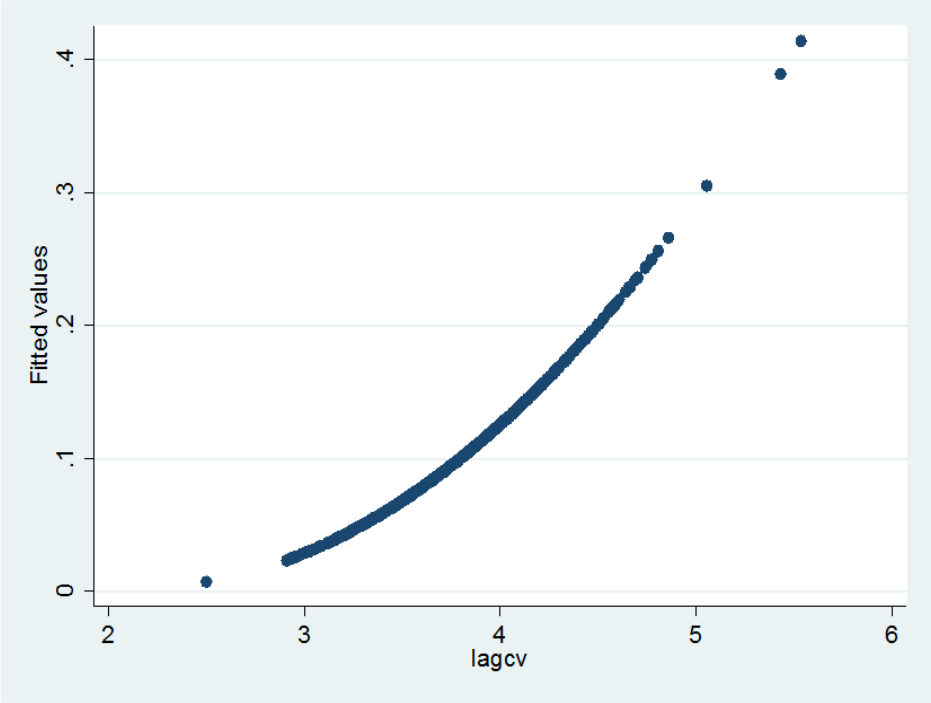
[41] Our estimates are in fact heteroskedasticity-robust and cluster-robust, see Cameron and Trivedi (2009), p. 85.

[42] Especially for the description of the variables and the material on the literature review, we thank Sonja Bohnet, née Rabus; see also Baten and Rabus (2007).

empirical studies on conflicts, we will discuss them only briefly. The sources and exact definitions of these variables can be found in the appendix.

Democracy. Intuitively, we would expect that a democratically organised country would have less risk of facing a civil war (Skaperdas 2008; Reynal-Querol 2005). On the other hand, one could imagine that repressive regimes try to impede the outbreak of civil wars through repression (Hegre et al. 2001).[43] As a large strand of literature is engaged in disentangling the effects of the *ethnic composition* (Sambanis 2001; Fearon and Laitin 2003), we also control for these effects.[44] In addition, we include *population size* as a control variable, because a larger population makes it more likely that the critical threshold of 1,000 battle-related deaths will be reached.

Figure 3.2: The probability of civil war onset subject to inequality



[43] We test the non-monotonic hypothesis by introducing the squared term of this variable in one of our models. Another strategy would be concessions: Aidt and Jensen (2011) as well as Acemoglu and Robinson (2000) showed that European governments increased voting rights from the 19th to 20th century when they were faced with the threat of a conflict. We also test a specification with a percentage change in democracy from the previous to the current period to control for policy changes that have been driven by the threat of political unrest.

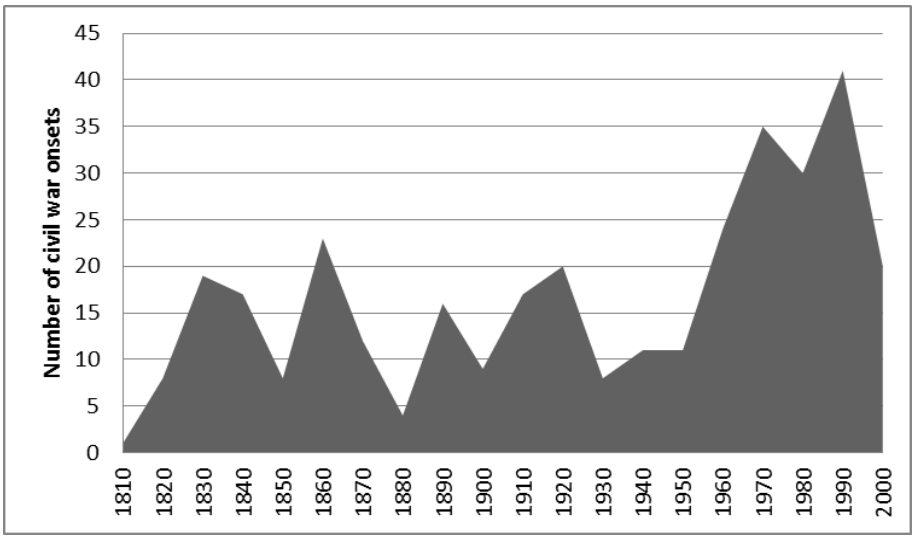
[44] As there is no agreement in previous literature which measure of ethnic composition is best, we take the most common ethnic fractionalisation measure but test whether our results change if we introduce different measures in Table B5.

We also consider the country's *colonial background* that might be positively or negatively correlated with the onset of civil war, depending on whether dissatisfaction of the colonised outweighs the fear of military reactions to riots. Finally, we test whether the idea holds true that rebels finance their activities based on natural resources, and therefore introduce a dummy variable for *diamond deposits* as a "greed" component.[45] As other papers have found diamonds to be positively correlated with civil wars (Ross 2006; Smillie 2002), we expect a positive sign.

3.3.1 Descriptive statistics

How did the general trend of civil war occurrence develop over the last two centuries? In general, the number of conflicts was relatively constant until WWII, with approximately 10-15 major civil wars per decade exceeding the threshold of 1,000 battle-related deaths. After WWII, there was a clear increase in the number of civil wars, followed by a boom in the most recent period (over the past decade, the number has slightly declined again; see Figure 3.3).

Figure 3.3: Civil Wars 1820-2000



Sources: Data taken from the Correlates of War Project.

[45] A potential shortcoming is that we do not differentiate between primary (difficult to loot) and secondary (easy to loot) diamonds.

If we compare this development with the evolution of height over the past two centuries, we actually observe a modest correlation – one that is opposite to the expected direction. Heights were relatively constant in the first period (until approximately 1860-1890) and started to increase in the 20th century, most notably in Western and Eastern Europe and European settlements. In Africa and East Asia, a certain increase in height between the 1890s and 1950s can also be observed (Figure 3.4a). Hence, if we observe some influence of height on the probability of civil war outbreak, it is most likely not due to a trend correlation – the trend developments of the two series would suggest a correlation in the opposite direction. Notwithstanding these observations, Africa experienced a period of decreasing heights afterwards (Moradi 2005).

Looking at inequality trends by world region, no overall trend is visible (Figure 3.4b). The levels of inequality were generally quite high in Latin America, at least since the late 19th century, which is also confirmed in other studies (Van Zanden et al. 2014). In Europe (both East and West) and Asia inequality levels were generally lower. Western Europe's inequality levels decreased between the 19th and 20th centuries. Sub-Saharan African inequality in contrast increased substantially between the first and the second half of the 20th century, consistent with what we know about civil war trends.

An examination of the descriptive statistics already offers insight into possible outcomes of our regression analyses. We observe, for instance, that civil war-ridden countries are less democratic (-2.57) than their peaceful counterparts (-0.21). Lagged height was in fact lower in the observations with incidence of civil war. Most important for the present study, we do observe higher inequality within countries that experienced a civil war. The coefficient of height variation equals 3.93 in countries that experience a new civil war compared to 3.75 in countries without a new civil war. In the upper panel, we document all of the cases, whereas the bottom panel shows the descriptives for the cases of Table 3.3 in which none of the explanatory variables are missing. The correspondence between both panels is high. We will assess missing value selectivity in greater detail below. We also took a closer look at the functional forms of inequality, height and democracy. Theories of non-monotonic relationships between inequality and civil war cannot be confirmed for our data. Figure 3.2 shows that civil war probability is

rising in an almost linear way, at the most a slightly exponential function can be assumed.

Figure 3.4.a: Height trends estimated by world regions.

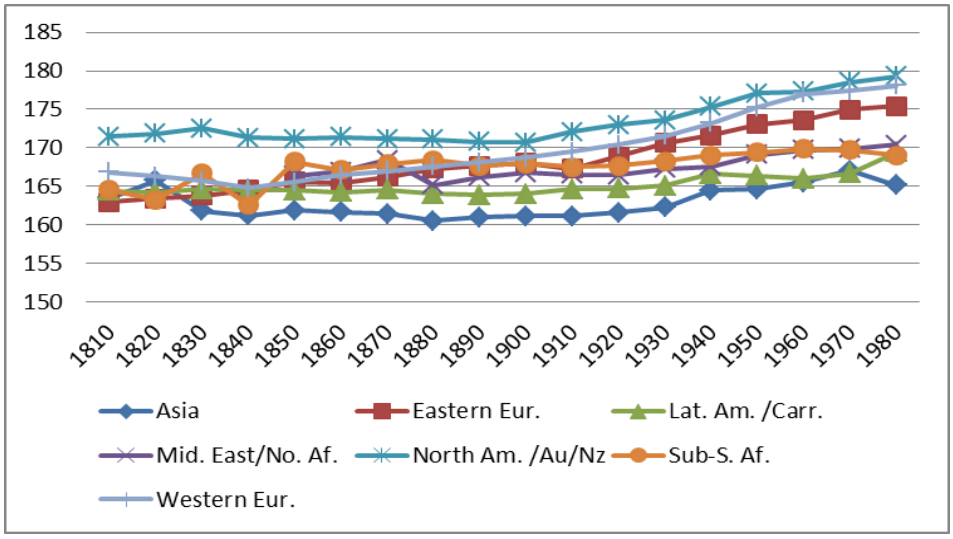
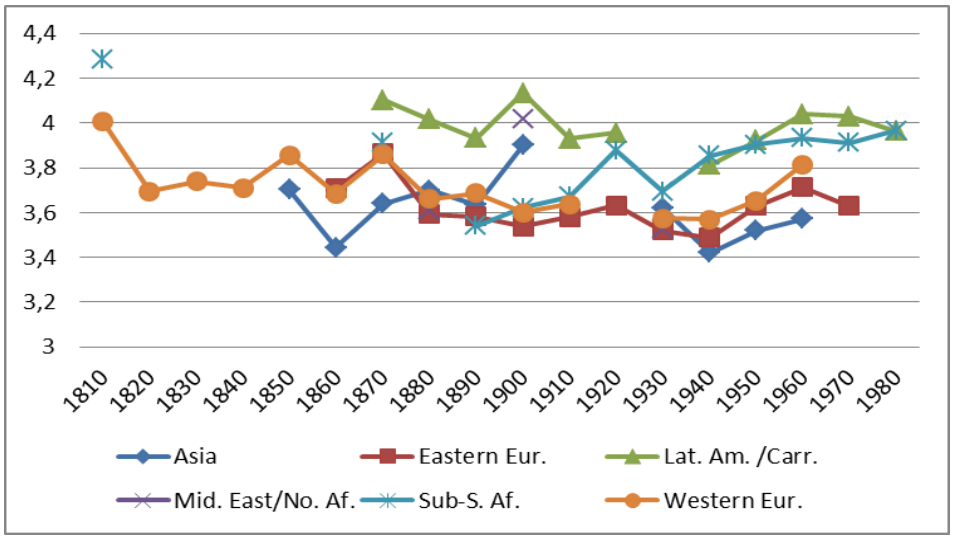


Figure 3.4.b: Inequality trends estimated by world regions



Note: We omitted data points with less than four countries per given decade in a world region.
Source: Baten and Blum (2012).

Table 3.2: Descriptive statistics

Variable	Obs	Mean	Std. Dev.	Mean if cwon=1	Mean if cwon=0
Civil War Onset	3380	0.07	0.25	1	0
Inequality	708	3.77	0.37	3.93	3.75
Height	1330	1.68	0.05	1.66	1.68
Av. Conflict years t-1	3211	0.19	0.99	1.07	0.13
Colony	3380	0.22	0.41	0.09	0.23
Democracy	1525	-0.54	6.69	-2.57	-0.21
Democracy^2	1525	0.45	0.35	0.31	0.47
Diamond	3380	0.13	0.34	0.24	0.12
Ethn. Fract.	3140	0.46	0.26	0.47	0.46
Language Fract.	3100	0.40	0.28	0.38	0.40
Religious Fract.	3200	0.43	0.23	0.37	0.43
Population (log)	3199	7.85	1.84	9.31	7.74
Peace Duration	3380	7.39	5.70	5.20	7.55
Only nonmissing values for main specification of Table 3 (model 1 and 2)					
Civil War Onset	403	0.16	0.36	1	0
Inequality	403	3.80	0.36	3.94	3.77
Height	403	1.69	0.05	1.66	1.69
Av. Conflict years t-1	403	0.41	1.45	0.96	0.30
Colony	403	0.06	0.24	0.08	0.06
Democracy	403	-0.16	6.78	-2.29	0.23
Democracy^2	403	0.46	0.35	0.29	0.49
Diamond	403	0.16	0.37	0.24	0.14
Ethn. Fract.	383	0.41	0.28	0.44	0.40
Language Fract.	375	0.33	0.30	0.31	0.33
Religious Fract.	384	0.44	0.24	0.39	0.45
Population (log)	403	9.43	1.39	9.61	9.40
Peace Duration	403	7.53	5.96	4.10	8.16

Note: The sample includes 224 country-decade observations in which a civil war took place. The absolute number of civil wars within the observed time period is higher (306 civil wars). Height and inequality are lagged by one decade. Source: see Appendix B.

When we tested the relationship by controlling for inequality and its squared term in a regression analysis, we did not find a significant non-monotonic relationship either.[46] We therefore abandoned the idea that inequality might affect civil war probability in a non-monotonic way and do not use other functional forms of inequality in our regressions.[47]

As units are probably statistically related over time, we have to account for potential serial correlation problems. Beck et al. (1998) propose to use the discrete logistic model of the form

$$\mathrm{P}(y_{i,t} = 1|x_{i.t}) = \mathrm{h}(\mathrm{t}|x_{i.t}) = \frac{1}{1+e^{-(x_{i,t}ß+\mathrm{K}t-t0)}}$$

where κ_{t-t0} denotes a dummy variable measuring the time of peace until time t. This model has been applied, among others, by Aidt and Jensen (2009). However, temporal dummies should *not* be applied if the null hypothesis of temporal independence is not rejected as unnecessary multicollinearity would be the consequence (Beck et al., 1998, p. 1269). This is the case in our data (p=0.4312), possibly not because there is no path dependence at all, but rather because we use decades instead of yearly observations. Although the above mentioned model does not seem to fit for our data, we are taking potential serial correlation seriously. We therefore cluster standard errors at the country level in every specification and employ variables that control for war persistency.[48] War persistency is either measured by the absolute number of peace decades, which is adopted from the idea of introducing spell counters above, just using the absolute values instead of dummy variables.[49] As an alternative measure we introduce the variable "warlast" that measures how many years of conflict took place in country i during the previous decade. While the former variable takes into account the entire period of time,

[46] Regressions not reported here, but available from the authors.
[47] The probability of the onset of civil war subject to democracy is decreasing linearly with higher levels of democracy (Figure B1). However, regression analysis suggests that there might also be a non-monotonic relationship between the political regime and civil war probability. To avoid functional form misspecifications, we always use democracy and its squared term in the regression analyses.
[48] This is the standard solution to this problem in civil war literature, see for example Miguel et al. (2004).
[49] The underlying assumption would be that the probability of facing a civil war decreases linearly with peace duration, which might be a rather strong assumption. However results do not change if we only take into account the previous decade.

the latter shifts the focus to the short run, relying on the assumption that it might be rather violent action in the recent past that leads to the outbreak of new conflicts. We ran the regressions with both specifications and received the same outcome for our main variables, so we generally keep to the long-term perspective of war persistency and use the short-term variable only in some of the specifications to prove the robustness of the results.

3.3.2 Regression analysis

We use different sets of variables and models to test the robustness of our results. We expect that inequality increases the likelihood of civil war, whereas height is negatively related with the onset of civil war.

In models 1 to 4 of Table 3.3, we use the same set of variables – only exchanging long- and short term war persistency controls in one specification- with pooled logit, panel logit and rare events logit models. The rare events model takes into account that the event of a civil war is rather rare compared to periods without new civil wars and generates approximately unbiased and lower-variance estimates of logit coefficients and their variance-covariance matrix.[50] We find that inequality in fact increases the probability of civil war. Similarly, height – as a measure of non-deprivation – reduces this probability. Hence, both hypotheses were confirmed and statistically significant throughout the models.

Apart from our two main variables, we find that countries under colonial rule were at higher risk of facing civil strife.[51] Our long-term measure of peace duration indicates.

[50] It was not possible to report marginal effects for the rare events logit model with our statistical software. But it is possible to calculate the probability of the onset of civil war manually: If we set all explanatory variables at their mean and increase inequality from the 20th to 80th percentile, the possibility of a new civil war increases by 0.031 or by 0.164 if we increase inequality from the mean to the maximum level.

[51] The coefficients for the population size are positive and sometimes positive, as expected. In some cases, the relationship between democracy and civil war seems to be bell-shaped. However, the turning point would be beyond all data points we observe in our panel, therefore our data set only covers the observations left to the turning point. We tentatively conclude countries with very high levels of democracy are at lower risk of experiencing a new war, as squared democracy has a negative sign. But this squared term of the political system variable is only significant in some of the specifications. The possibility of a new civil war does not seem to be reduced if a country experiences a shift towards more democracy (model 5).

Table 3.3: Regressions of civil war onset

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Estimation Method	PLOG	XTLOG	XTLOG	RELOG	PLOG	XTLOG	XTLOG	XTLOG	XTLOG	XTLOG
Marginal Effects?	Y	Y	Y	N	Y	Y	Y	Y	Y	Y
Inequality	0.051*	0.055*	0.059*	0.685**	0.067**	0.070*	0.088**	0.059*	0.069*	0.079***
	(0.066)	(0.075)	(0.068)	(0.031)	(0.013)	(0.057)	(0.019)	(0.078)	(0.094)	(0.005)
Height	-0.885*	-0.989**	-1.064**	-9.701**	-0.923*	-1.148**	-1.069**	-1.079**	-1.267***	-0.819***
	(0.051)	(0.032)	(0.019)	(0.045)	(0.063)	(0.026)	(0.035)	(0.019)	(0.006)	(0.005)
Population (log)	0.028*	0.033**	0.038**	0.208	0.018	0.035**	0.020	0.016	0.043**	
	(0.056)	(0.036)	(0.014)	(0.106)	(0.101)	(0.037)	(0.150)	(0.252)	(0.012)	
Democracy	0.001	0.038	0.021	-3.649	-0.352	-0.036	-0.245	-0.350	0.193	
	(0.997)	(0.907)	(0.951)	(0.188)	(0.119)	(0.918)	(0.499)	(0.237)	(0.581)	
Democracy^2	-0.057	-0.068	-0.078*	-0.920*		-0.046	-0.109*	-0.109*		
	(0.211)	(0.139)	(0.093)	(0.082)		(0.426)	(0.056)	(0.051)		
Colony	0.144**	0.151**	0.151**	1.224**		0.179***	0.146**	0.106*		
	(0.030)	(0.021)	(0.015)	(0.043)		(0.010)	(0.049)	(0.065)		
Peace Duration	-0.006*	-0.004		-0.076**	-0.010***	-0.003	-0.005	-0.008**		
	(0.064)	(0.225)		(0.040)	(0.001)	(0.320)	(0.135)	(0.032)		
Warlast			0.010							
			(0.200)							
Policy Change					-0.001					
					(0.737)					

Table 3.3 (cont.)

Height Growth						-2.002				
						(0.445)				
Diamond							0.024	0.024		
							(0.699)	(0.666)		
Ethn. Fract.							0.031	0.030		
							(0.727)	(0.645)		
Time dummies?	Y	Y	Y	N	Y	Y	Y	N	Y	Y
Wreg dummies?	Y	Y	Y	N	N	Y	N	N	Y	N
N	403	403	403	375	356	364	383	383	403	663

Notes: Heteroskedasticity-robust (country-) clustered standard errors applied in every model. P-values in parentheses, ***, **, * significant on the 1, 5, and 10%-level respectively. Note: Diamond mining and colonial status are defined as dummy variables. Fractionalisation measures are time invariant. For expository purposes, we divided the variables democracy and democracy squared by 100 before running the regressions. Marginal Effects reported except for rare events logit model (model 5). Inequality is proxied by height cv, absolute deprivation is proxied by height, both lagged by 1 decade. Peace duration: sequence of decades where no war has started up to current period. Abbreviations: PLOG: pooled logit, XTLOG: panel logit, RELOG: rare events logit. Wreg dummies: Dummies for world regions.

that countries that have not faced civil war for longer time periods are less prone to face conflicts in the future. In contrast, the *warlast* variable suggests that countries that were susceptible to war during the previous decade do not face higher risk of having a new war in the near future.

Model 6 introduces the growth rate of height to assess whether changes in well-being rather than absolute or relative well-being are responsible for dissatisfaction. For example, people might feel more deprived if the overall well-being in previous periods was better compared with the current situation. Changing conditions in well-being proxied by height growth does not seem to generate sufficient dissatisfaction for conflict (model 6).

Ethnic fractionalisation and the existence of diamonds are added in models 7 and 8. None of these variables turns significant. In most of the models, we include time and world region effects, but omit them in some of the models to see whether our results stay robust. In sum, inequality and absolute deprivation remain significant in every model (see Appendix B for the robustness of the results).

As a robustness test, we also ran linear probability regressions (Table 3.4). Our main variable inequality remains positive and significant throughout the different models, while absolute deprivation only becomes significant in the random and fixed effects models.[52]

In Table 3.5, we test whether the results remain stable across different income levels by omitting either very rich or very poor countries.[53] Inequality turns insignificant if we exclude least developed countries. If we exclude rich countries, inequality is significant and positively related with the onset of civil wars and the coefficients are much bigger than in our baseline specifications. We therefore conclude that the impact

[52] Note however, that we do not regard the fixed effects specification as the best model for our data. Statistical literature argues that using fixed effects might lead to inefficient results if the between-variation is better measured than the within variation, because it puts much less focus on the between variation (see Cameron and Trivedi 2009, p. 244, among others). Moreover, if we use fixed effects we have to assume that unobserved heterogeneity is consistent over time, which is a very strong assumption for such a long time period. Therefore, we only include some fixed effects specifications as robustness tests.

[53] To exclude poor countries, we drop countries with a GDP p.c. less than 1,000 US $. We define rich countries as those that have a GDP with more than two standard deviations above the mean GDP of our sample.

Table 3.4: Linear probability model of civil war outbreak

	(1)	(2)	(3)	(4)
Estimation Method	XTREG	RE	XTREG	FE
Inequality	0.121**	0.135**	0.124**	0.084*
	(0.014)	(0.011)	(0.018)	(0.056)
Height	-0.47	-0.965*	-0.626	-1.351**
	(0.469)	(0.055)	(0.370)	(0.037)
Population (log)	0.026	0.018	0.028*	
	(0.201)	(0.202)	(0.092)	
Democracy	0.298	-0.176	0.382	
	(0.521)	(0.579)	(0.428)	
Democracy^2	-0.056	-0.0762	-0.065	
	(0.341)	(0.202)	(0.260)	
Colony	0.161*	0.143*	0.157	
	(0.093)	(0.091)	(0.105)	
Spell Counter	-0.006	-0.009**	-0.005	
	(0.199)	(0.021)	(0.291)	
Ethn. Fract.			-0.051	
			(0.686)	
Diamond			0.019	
			(0.810)	
Time dummies?	Y	Y	Y	Y
Wreg dummies?	Y	N	Y	N
Constant	0.196	1.124	0.414	2.041*
	(0.853)	(0.216)	(0.713)	(0.062)
N	403	403	383	663
Log lik.				-17.06
Chi-squared	274.6	60.41	345.1	
R^2	0.169	0.169	0.052	0.052

Notes: Heteroskedasticity-robust clustered standard errors. P-values in parentheses, ***, **, * significant on the 1, 5, and 10%-level respectively. Note: Diamond mining and colonial status are defined as dummy variables, Fractionalisation measures are time invariant. For expository purposes, we divided the variables democracy and democracy squared by 100 before running the regressions. Inequality is proxied by height cv, absolute deprivation is proxied by height, both lagged by 1 decade. Peace duration: sequence of decades where no war has started up to current period. In model 4, the within-R^2 is reported. Other notes: see Table 3.3.

Table 3.5: Robustness tests: panel logit omitting the very rich and very poor countries

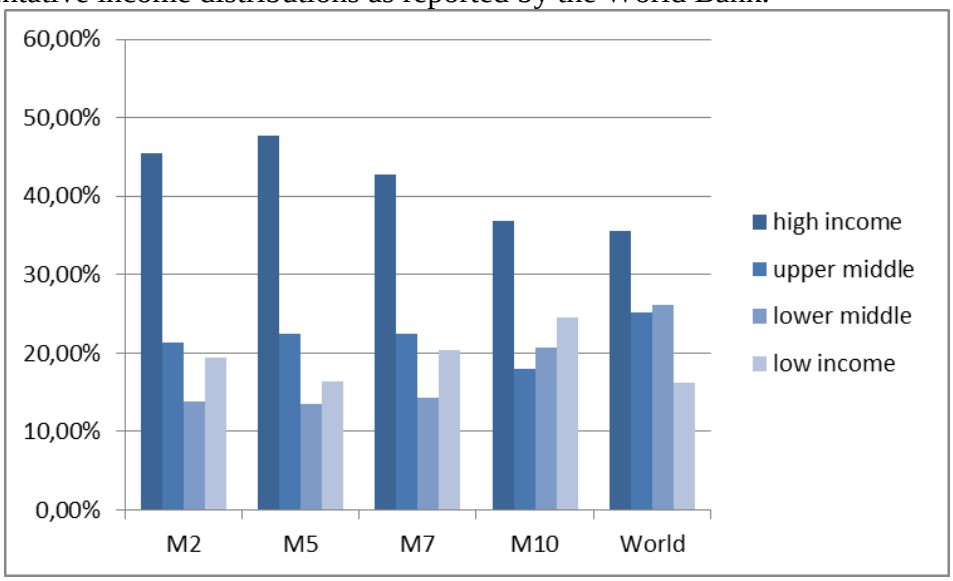
	(1)	(2)	(3)	(4)
Omitted	GDP p.c.<1000 US$		GDP p.c.>13200 US$	
Inequality	0.023	0.063	0.106**	0.098*
	(0.497)	(0.126)	(0.041)	(0.087)
Height	-1.113***	-0.986**	-0.790	-1.275***
	(0.004)	(0.046)	(0.159)	(0.006)
Population (log)	0.027*	0.003	0.014	0.020
	(0.072)	(0.863)	(0.474)	(0.245)
Democracy	0.114	-0.191	0.132	-0.094
	(0.651)	(0.555)	(0.774)	(0.817)
Democracy^2	-0.044	-0.082	-0.033	-0.071
	(0.321)	(0.142)	(0.554)	(0.264)
Colony	0.062	0.020	0.155**	0.160**
	(0.491)	(0.872)	(0.038)	(0.031)
Peace duration	-0.001	-0.006	-0.005	-0.006
	(0.660)	(0.139)	(0.189)	(0.120)
Diamond		0.044		0.025
		(0.607)		(0.631)
Ethn. Fract.		0.043		0.032
		(0.621)		(0.649)
Time dummies?	N	Y	Y	Y
Wreg dummies?	Y	N	Y	N
N	303	284	287	284
Log lik.	-95.32	-100.1	-97.62	-98.46
Chi-squared	342.5	245.0	147.1	157.8

Notes: Estimation: Pooled logit with heteroskedasticity-robust clustered standard errors. P-values in parentheses, ***, **, * significant on the 1, 5, and 10%-level respectively. Marginal effects reported. Note: Diamond mining and colonial status are defined as dummy variables. Fractionalisation measures are time invariant. For expository purposes, we divided the variables democracy and democracy squared by 100 before running the regressions.

of inequality on the onset of civil war is much higher in poor countries. Absolute deprivation plays a role across all income levels.

When looking at the different models, differences in the number of observations can be observed, which is mainly due to missing values for some of the explanatory variables. We want to determine whether these missing values might have resulted in a missing value sample selection problem. In other words, do we have a very special subsample due to missing values in some of the specifications? We tested this possibility by assessing whether countries of a certain income range have been over- or underrepresented in one of the models. We also checked whether the distribution of observations within certain income groups changed between the models (Figure 3.5). We found that our models with few explanatory variables draw an almost perfect mirror image of the real income distributions in the world (Table 3.3, model 10 compared to calculations of the World Bank).

Figure 3.5: Data selection within the models of Table 3 by income group compared to representative income distributions as reported by the World Bank.



Source of data for models: Baten and Blum (2012). Notes: Income levels as defined by World Bank: low income: 1,005$ or less, lower middle income: 1,006$-3,975$, upper middle income: 3,976-12,275$, high income: 12,276$ or higher. Source of income classifications and distribution of income: World Bank, World Development Indicators.

In the other models, high income countries are modestly overrepresented, while lower middle income countries are modestly underrepresented. However, income levels

do not differ vastly from the real distribution in any of the models. Low income countries are always sufficiently covered. It is also important to note that particularly war-struck regions such as Africa and Latin America are quite well covered in our data.[54] Therefore, we conclude that missing value sample selection that might lead to omitting the poorest countries is not a problem here.

3.3.3 Instrumental variable models

In what follows, we will dwell on endogeneity issues. The results of the ordinary least squares regressions could be affected by reverse causality. Civil war may lead to a decrease in children's height (see, for example, Bundervoet et al. 2009) and perhaps also a change in height dispersion.[55] Instrumental variable (IV) estimation allows us to circumvent these issues of endogeneity. Which instrumental variables could be suited for this purpose? Easterly (2007) and Galor et al. (2009) have recently advocated the use of climatic, geological and similar variables, which proxy types of agriculture that correlate either with higher or lower efficient sizes of scale.[56] Our instrumental variables for inequality will be: (1) the ratio of soil and climatic suitability for sugar cane relative to wheat and (2) low population density in 1500 interacted with southern location. Sugar plantation and cattle-raising for hide and beef exports are typical examples for economies of scale in agricultural production: The owner of a sugar plantation in Cuba or Brazil will aim at producing on a large scale by employing a high number of slaves or – later – free labourers on large plantations, because higher scale increases revenues much more than costs. Likewise, an Argentinean or Australian cattle baron will increase his herd and the amount of pasture to enormous values. Relative to sugar cane, wheat production is already highly productive on much smaller farm units as has been amply demonstrated in the agricultural economics literature. Sugar and wheat production requires relatively clear-cut climatic and soil characteristics. Hence, we can use those to proxy the suitability for the "inequality crop" sugar and the "equality crop" wheat. In

[54] Table available from the authors.
[55] See also Gupta et al. (2004) on the armed conflict effects on macroeconomic stability (albeit not on health spending).
[56] The reason behind this is that economies of scale usually go hand in hand with more inequality, as more people will be working for large landowners without having their own piece of land.

the spirit of Easterly's (2007) famous instrumental variable, we take the ratio between the two.

The cattle-raising activity associated with inequality is unfortunately less concentrated on specific soils. But there is a clear correlation with Southern location and initially low population density. Consequently, we use the interaction term of these two variables as additional instrumental variable.[57]

The advantage of the ratio between the climatic and geological suitability ratio of sugar and wheat is its intrinsically exogenous nature, whereas the actual crop use could be influenced by civil wars. Similarly, population density around 1500 is a very popular instrumental variable, because it captures human development in a very early time period (it was prominently used by Acemoglu, Johnson, and Robinson 2002, for example). The autocorrelation of early population densities and those of the 20th century is quite limited due to the unequal population increase in some world regions and the massive migration movements. Similarly, it is likely that Southern latitude is exogenous. The second IV is only included in some of the specifications, as our first stage results show that the IV's correlation with inequality might not be strong enough. We find that the results do not depend on it.

For height levels, we use lactose tolerance as an instrumental variable. Baten and Blum (2012) have summarised the literature on diminished protein consumption as a result of lactose intolerance and find clear empirical evidence for this relationship in their econometric analysis. As we use lactose tolerance instead of lactose intolerance as an instrument, we expect positive signs for this IV.

In addition to an IV probit model, we test two-stage least squares (from now on: 2SLS) models. Angrist and Pischke (2009, pp. 19) argue that using OLS models might also be preferable in the case of limited dependent variables, as they have conceptual robustness advantages. Wooldridge (2002: 594 and 596) confirms that the 2SLS estimates of a linear model provide good approximates for the average partial effects of

[57] Argentina became the prototype of this type of land use, because the indigenous Indian population on its great plains was always very sparse, and in contrast to the United States, European immigration was relatively limited in numbers until the late 19th century. Apart from Argentina and Australia, also South Africa, New Zealand and Uruguay had very unequal distributions following the colonial land grab (Eastwood et al. 2010; Juif and Baten 2014). Thus, we instrument this kind of inequality agriculture with Southern latitude interacted with population density in 1500.

bivariate probit models. We use limited information maximum likelihood (LIML) techniques in cases where our F-statistics were relatively low.

The results of the two-stage least squares regressions confirm that we have strong instruments for inequality and height.[58] The respective instruments for height and inequality are strongly correlated with our endogenous variables, as shown in the first stage of Table 3.6. The Angrist-Pischke multivariate F-test is above or near the critical threshold of 10 (Stock and Yogo 2002) in case of the 2SLS specifications (models 2 and 3). The F-value for the inequality instruments is below the critical threshold in the LIML specifications, but the Anderson-Rubin test, which is robust to the presence of weak instruments, rejects the null hypothesis that the coefficients of the endogenous regressors in the structural equation are jointly equal to zero in every model. We conclude that we do not have a weak instruments problem here. The Kleibergen-Paap statistic clearly shows that our reduced form model is not underidentified.

Looking at the second stage, the effect of inequality on the likelihood of civil war is confirmed. The relative importance of our inequality variable is not trivial. With full standardisation, we find that an increase in inequality by one standard deviation results in more than half a standard deviation increase in the onset of civil war (0.67 in model 2 of the IV Table 3.6). This is certainly a substantial economic effect. Using the OLS results above, a one standard deviation increase in inequality leads to only 0.1 standard deviation effects (if we use model 1 of Table 3.3). The higher impact in the IV models is probably a result of the reduced measurement error compared to previous models without instrumental variables. Nunn (2008, pp. 159-163) emphasised that the second function of instrumental variable techniques – to estimate with less measurement error – results sometimes in larger coefficients of the second stage, compared to OLS estimates. If the instrumented variable is measured with a certain amount of error, while the instruments are not, it is not astonishing if the coefficients are larger.

[58] As we have two endogenous variables, we use the Angrist-Pischke F-statistics, as the use of the overall F-statistic might dissemble a well-identified first stage, although only one instrument is the reason for a high F.

Table 3.6: IV-regressions of civil war

	(1)	(2)	(3)	(4)	(5)
Estimation Method	IVPROBIT	TSLS	TSLS	LIML	LIML
First stage	Dependent Variable: Inequality				
(1) Lactose Tolerance	0.235**	0.240	0.235	0.197	0.243
	(0.028)	(0.104)	(0.208)	(0.328)	(0.221)
(2) Wheat/Sugar	-0.610***	-0.623***	-0.610***	-0.626**	-0.613***
	(0.000)	(0.001)	(0.003)	(0.010)	(0.004)
(3)Lowpop*Southern					0.000
					(0.891)
First stage	Dependent Variable: Height				
(1) Lactose tolerance	0.691***	0.067***	0.069***	0.074***	0.068***
	(0.000)	(0.000)	(0.001)	(0.001)	(0.002)
(2) Wheat/sugar	0.024*	0.028	0.024	0.059*	0.020
	(0.093)	(0.315)	(0.483)	(0.085)	(0.575)
(3) Lowpop*Southern					0.000
					(0.904)
Second stage	Dependent Variable: Civil War Onset				
Inequality	2.614**	0.464***	0.515**	0.502**	0.527**
	(0.050)	(0.004)	(0.036)	(0.045)	(0.044)
Height	-8.218	-1.758	-1.666	-1.664	-1.762
	(0.184)	(0.113)	(0.220)	(0.216)	(0.208)
Population (logs)	0.231**	0.025	0.037	0.043	0.037
	(0.021)	(0.255)	(0.277)	(0.201)	(0.294)
Democracy	-2.755		-0.253	-0.365	-0.243
	(0.211)		(0.602)	(0.491)	(0.622)
Democracy^2	-0.126		0.002	0.046	0.015
	(0.792)		(0.988)	(0.686)	(0.901)
Colony	0.316	-0.091*	0.035	0.136	-0.026
	(0.616)	(0.059)	(0.777)	(0.273)	(0.822)
Peace Duration	-0.000	0.004	0.002	-0.000	0.001
	(0.996)	(0.526)	(0.716)	(0.967)	(0.833)
Constant	0.430	1.085	0.634	0.295	0.754
	(0.973)	(0.598)	(0.816)	(0.918)	(0.780)
Time dummies?	N	N	N	Y	N
N	250	368	250	250	242
AP-F height		33.82	24.48	31.13	13.2
AP-F inequality		11.65	9.53	6.49	4.6
Kleinbergen-Paap Lm stat. p-val.		0.002	0.005	0.014	0.023
Anderson-Rubin p-val.		0.000	0.013	0.003	0.012
Hansen p-val.	exactly identified				0.578

Notes: Heteroskedasticity and cluster-robust standard errors. Instruments: (1) Lactose tolerance; (2) Sugar/wheat suitability ratio; (3) Low population density * southern latitude. It was not possible to obtain marginal effects for IVPROBIT two-step estimates (model 1), therefore no marginal effects are reported in this table. P-values in parentheses, ***, **, * significant on the 1, 5, and 10%-level respectively. AP-F are Angrist-Pischke F-tests. Colonial status is defined as dummy variable. For expository purposes, we divided the variables democracy and democracy^2 by 100 before running the regressions**.**

This is certainly the case for our variable "inequality", because all inequality evidence is known to suffer from some degree of measurement error. Hence, the seriousness of this caveat is reduced with the instrumental variable techniques as well.

We would argue that the instruments influence the dependent variable only through the potentially endogenous variable, inequality (see the discussion on the exclusion restriction below). The p-value of the Durbin-Wu-Hausman test, which could be calculated for models 2 (p-value: 0.037) and 3 (p-value: 0.178), indicates that the IV-approach is not strictly necessary in every case, as the results are not significantly different from OLS estimates, at least if we control for democracy and its square. Any endogeneity among the explanatory variables would not have deleterious effects on OLS estimates. Nevertheless, given the general suspicion that all macroeconomic variables could be endogenous, it is reassuring that the significant impact of inequality remains a consistent determinant of an increased risk of civil war. In contrast, height levels are not significant once instrumental variables are used. This might also be caused by the lower number of cases available for this estimation – the sizes of the coefficients are not small. Most of the other controls are insignificant.

3.3.4 The exclusion restriction

One of the biggest challenges in any instrumental variable approach is the requirement of the exclusion restriction, which implies that the instrumental variables do not have a direct influence on the ultimate dependent variable except via the potentially endogenous variable. In his seminal paper, Easterly (2007) studied the applicability of the exclusion restriction of relative soil and climatic suitability by using both theoretical reasoning and econometric tests. One possibility for such a direct causal channel is that wheat and sugar have different effects on the wealth of the local population. This wealth difference could be a potential direct causal influence on dissatisfaction and conflict. On the other hand, Easterly argues convincingly that the difference in the wealth effects of those agricultural goods are quite limited compared to all of the other goods that countries are producing.

Another potential violation of the exclusion restriction could stem from the widely discussed concept of the "natural resource curse". Exceptionally high incomes from raw material exports might generate rents that in turn could lead to political economy problems (Sachs und Warner 1995b; Auty 1993, see also the recent review by Frankel 2010). Sugar cane is a primary product that might produce such high windfall profits, for example. Isham et al. (2005) have developed a theory of "point-source" agricultural exports. Typical cases are exports such as sugar cane. The idea is that the "point-source" export revenues can more easily be captured by ruling elites than "diffuse" exports such as wheat. Easterly (2007) argues that if these "resource curse" effects operate via inequality, the exclusion restriction is of course not violated. Most of the studies discussing these issues emphasise that the behaviour of rich elites and their interactions with the institutional environment is the main issue, which is consistent with the inequality story (Easterly 2007; Isham et al. 2005).

Nevertheless, one can still imagine that the resource curse works through other channels. One strategy to address these issues is to directly include additional controls for a resource-oriented export structure and determine whether inequality, measured with the sugar/wheat suitability variable, turns insignificant. We again follow the literature in applying this strategy (Easterly 2007; Juif and Baten 2014). We construct a variable of the share of raw material and mining exports relative to the country's total exports. The "resource curse" variable is insignificant and does not affect the significance of inequality measured by the sugar-wheat-suitability variable (Table 3.7).

What about the theoretical properties of the instrumental variable "low population density in 1500 interacted with southern location"? Low population density could, for example, be negatively correlated with civil wars, because the probability of facing a civil war decreases in sparsely populated countries. However, the population density around 1500 does not have much in common with the population density in the 19th and 20th centuries. To be on the safe side we only included this IV in model 5 of Table 3.6, and the inequality coefficient does not differ much from the others.

In the case of the last instrument, lactose tolerance, the discussion of the exclusion restriction is relatively straightforward, as lactose tolerance is difficult to imagine having a separate impact on a civil war onset, except via the anthropometric

Table 3.7: IV-regressions on civil war onset, controlling for primary goods exports

	(1)	(2)	(3)
	IVPROBIT	TSLS	LIML
First stage	Dep. variable: Inequality		
(1) Lactose tolerance	0.156	0.072	0.082
	(0.158)	(0.692)	(0.667)
(2) Wheat/Sugar	-0.708***	-0.855***	-0.858***
	(0.000)	(0.000)	(0.000)
(3) Lowpop*Southern			0.000
			(0.790)
First stage dep. variable: height	Dep. variable: Height		
(1) Lactose tolerance	0.075***	0.082***	0.080***
	(0.000)	(0.000)	(0.001)
(2) Wheat/sugar	0.025*	0.069*	0.069*
	(0.116)	(0.062)	(0.066)
(3) Lowpop*Southern			-0.000
			(0.829)
Second stage	Dep. variable: Civil war onset		
Inequality	2.156*	0.431**	0.435**
	(0.067)	(0.019)	(0.019)
Height	-8.760	-1.847	-1.721
	(0.212)	(0.121)	(0.145)
Natural Resources	-0.002	-0.002	-0.002
	(0.685)	(0.272)	(0.299)
Population (logs)	0.022	-0.015	-0.018
	(0.854)	(0.401)	(0.323)
Democracy	-1.048	0.147	0.132
	(0.653)	(0.790)	(0.813)
Democracy^2	-0.027	0.042	0.042
	(0.957)	(0.723)	(0.719)
Colony	0.254	0.147	0.099
	(0.686)	(0.159)	(0.348)
Peace Duration	0.008	0.003	0.001
	(0.811)	(0.535)	(0.832)
Constant	4.996	1.521	1.320
	(0.722)	(0.535)	(0.587)
Time dummies?	N	Y	Y
N	228	228	225
AP-F height		17.98	5.23
AP-F inequality		10.6	9.17
Kleinbergen-Paap Lm stat. P-val.		0.020	0.065
Anderson-Rubin p-value		0.001	0.000
Hansen p-val.	exactly identified		0.316

Notes: Heteroskedasticity- and cluster-robust standard errors. P-values in parentheses, ***, **, * significant on the 1, 5, and 10%-level respectively. It was not possible to obtain marginal effects for IVPROBIT two-step estimates (model 1), therefore no marginal effects are reported in this table. Instruments: (1) Lactose tolerance; (2) Sugar/wheat suitability ratio; (3) Low population density * southern latitude. Angrist-Pischke F-values are reported. Colonial status is defined as dummy variable. For expository purposes, we divided the variables democracy and democracy^2 by 100 before running the regressions**.**

causal channel. We conclude that the issue of the exclusion restriction does not pose a major problem

3.4. Conclusions

Several studies have documented the negative effect of economic deprivation on civil war for the last few decades. In most cases, GDP per capita or its growth rate has been used to indicate an economy's level of development. When assessing the 306 civil wars that took place between 1816 and 1999, we find that anthropometric measures are powerful indicators for explaining the onset of civil war. A negative correlation of absolute welfare levels and the probability of civil war outbreak was confirmed in most of our results, but did not pass the instrumental variables tests. Relative deprivation measured by the height inequality, on the other hand, was positive and significant in all of the models and passed robustness tests.

We also explicitly addressed the issue of endogeneity of absolute and relative deprivation by introducing instrumental variables. We used lactose tolerance as well as climatic and geological factors that are correlated with inequalities. These turned out to be strong instruments. The IV regressions confirmed the robustness of our results regarding the effect of inequality on onset of civil war. The inequality coefficients remained negative and significant throughout every specification, passing robustness tests as well as instrumental variables estimation.

Our study took a long-term view, analysing civil wars over the last two centuries. This was only possible by the use of innovative methods of measuring absolute and relative deprivation. Relative deprivation has not been used in empirical civil war literature as there is a lack of data on inequality in several countries. Our study overcame the problem of data scarcity because of an extensive data base for inequality in well-being. The impact of inequality on civil war probability could be systematically tested and a significant impact is found in our study.

Appendix B

Variable definitions

Civil war is coded as a dichotomous variable adopting the value 1 if civil war broke out in given country and five-year period. It is defined as sustained combat with at least 1,000 battle-related deaths per year that takes place between the armed forces of a government and forces of another entity for central control or for local issues. Military and civilian deaths are counted. Sources: Correlates of War Project and Uppsala Conflict Data Project: http://www.correlatesofwar.org/

Colonydummy is coded as a dichotomous variable adopting the value 1 if a country was a colony. Source: Correlates of War 2 Project. *Colonial/Dependency Contiguity Data, 1816-2002*. Version 3.0

Democracy indicates the openness of democratic institutions in a country and is measured on a scale of -10 (low) to 10 (high). Source: Polity IV Project.

Diamond is coded as a dichotomous variable adopting the value 1 if a country had diamond deposits that could be extracted.

Ethnic fractionalisation: based on a combination of racial and linguistic characteristics and defined as 1 minus the Herfindahl index of group shares of these characteristics. Source: Alesina et al. (2003). Data available at http://www.nsd.uib.no/macrodataguide/set.html?id=16&sub=1.

Height describes the average adult male height in the respective country ten years prior to the time of observation (except for the instrumental variables regressions, where we take current height); measured in centimetres. Sources: Baten and

Blum (2012), Measure DHS (Demographic and Health Surveys) project and the World Health Organisation's (WHO) Global Database on Child Growth and Malnutrition.

Height growth is the growth rate of heights between two decades*: (height*$_t$ *– height* $_{t-1}$*)/ height*$_{t-1}$

Inequality is the coefficient of height variation at time t in the case of instrumental variables regressions and t-1 for all other specifications.

Language Fractionalisation is defined as 1- Herfindahl Index of linguistic group shares, which reflects the probability that two randomly selected persons belong do different groups. Source: Alesina et al. (2003). Data available at http://www.nsd.uib.no/macrodataguide/set.html?id=16&sub=1.

Natural resource exports: percentage value of raw materials and mining products, relative to total exports, around 1980. Source: World Bank Data 1999 (CD-Rom)

Religious Fractionalisation is defined as the probability that 2 randomly selected individuals belong to different religious groups. Source: Alesina et al. (2003). Data available at http://www.nsd.uib.no/macrodataguide/set.html?id=16&sub=1.

Peace duration is the number of decades that country i has not been affected by conflict. Source: Intra-State war data set (version 4.1, posted in March 2011) from the Correlates of War project

Population (log) is the log of a country's population at the beginning of a ten-year period. Sources: The World Bank and Maddison (2001).

Warlast counts the number of months a country has experienced internal conflicts during the previous decade and divides them by 12 to get the average number of

years. We include all intrastate conflicts (apart from civil wars also regional internal and intercommunal conflicts) as we want to capture the overall dissatisfaction. Source: Intra-State war data set (version 4.1, posted in March 2011) from the Correlates of War project.

Table B.1: World regions, individual countries, and birth decades: coverage of the data set (grey indicates that real data was available and was accepted for height and civil war)

		Birth decade																			
		18..									19..										20
World region	Country Iso-Code	10	20	30	40	50	60	70	80	90	00	10	20	30	40	50	60	70	80	90	00
as	BD					■	■	■	■							■	■		■	■	■
as	CN	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■		
as	HK													■	■						
as	ID	■			■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	
as	IN				■	■	■	■	■	■		■	■	■	■	■	■	■	■		
as	JP								■	■	■	■	■	■	■	■	■	■	■		
as	KH				■	■	■	■	■	■	■	■	■	■		■	■	■	■		■
as	KP								■	■	■			■	■	■	■	■	■		
as	KR							■	■	■	■				■	■	■	■	■		
as	LA				■	■	■	■		■	■	■	■	■	■				■	■	■
as	LK							■					■						■	■	■
as	MM					■	■	■	■	■	■		■		■				■	■	■
as	MN											■		■							
as	MY				■		■	■		■	■			■						■	
as	NP								■					■	■	■	■	■	■		■
as	PG								■				■	■	■				■		
as	PH						■	■	■	■				■	■				■	■	
as	PK				■	■	■	■		■			■	■	■					■	■
as	SG																	■			■
as	TH						■	■	■	■	■	■	■	■						■	
as	TP									■											■
as	TW					■	■	■	■	■	■	■	■	■	■	■	■	■			
as	VN			■	■	■	■	■	■	■	■	■	■	■					■	■	■
eeu	AL								■	■	■										■
eeu	AM					■	■		■	■	■	■			■		■	■	■	■	■
eeu	AZ					■	■									■	■	■	■		■
eeu	BA																				■
eeu	BG								■					■	■	■					
eeu	BY				■						■								■		
eeu	CS					■		■	■	■							■				■
eeu	CZ	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■		■			

Table B.1 (cont.)

		Birth decade																			
		18..									19..										20
World	Country Iso-Code	10	20	30	40	50	60	70	80	90	00	10	20	30	40	50	60	70	80	90	00
eeu	EE																				
eeu	GE																				
eeu	HR																				
eeu	HU																				
eeu	KG																				
eeu	KZ																				
eeu	LT																				
eeu	LV																				
eeu	MD																				
eeu	MK																				
eeu	PL																				
eeu	RO																				
eeu	RU																				
eeu	SI																				
eeu	SK																				
eeu	TJ																				
eeu	TM																				
eeu	UA																				
eeu	UZ																				
lac	AR																				
lac	BO																				
lac	BR																				
lac	CL																				
lac	CO																				
lac	CR																				
lac	CU																				
lac	DO																				
lac	EC																				
lac	GT																				
lac	GY																				
lac	HN																				
lac	HT																				
lac	JM																				

Table B.1 (cont.)

		Birth decade																			
		18..									19..										20
World	Country Iso-Code	10	20	30	40	50	60	70	80	90	00	10	20	30	40	50	60	70	80	90	00
lac	MX																				
lac	NI																				
lac	PA																				
lac	PE																				
lac	PR																				
lac	PY																				
lac	SV																				
lac	TT																				
lac	UY																				
lac	VE																				
men	AF																				
men	DZ																				
men	EG																				
men	ER																				
men	IL																				
men	IQ																				
men	IR																				
men	JO																				
men	KW																				
men	LB																				
men	LY																				
men	MA																				
men	OM																				
men	SA																				
men	SY																				
men	TN																				
men	TR																				
men	YE																				
naa	AU																				
naa	CA																				
naa	NZ																				
naa	US																				
ssa	AO																				

Table B.1 (cont.)

		Birth decade																			
		18..									19..										20
World	Country Iso-Code	10	20	30	40	50	60	70	80	90	00	10	20	30	40	50	60	70	80	90	00
ssa	BF																				
ssa	BI																				
ssa	BJ																				
ssa	BW																				
ssa	CD																				
ssa	CF																				
ssa	CG																				
ssa	CI																				
ssa	CM																				
ssa	ET																				
ssa	GA																				
ssa	GH																				
ssa	GM																				
ssa	GN																				
ssa	GQ																				
ssa	GW																				
ssa	KE																				
ssa	KM																				
ssa	IR																				
ssa	IS																				
ssa	MG																				
ssa	ML																				
ssa	MR																				
ssa	MU																				
ssa	MW																				
ssa	MZ																				
ssa	NA																				
ssa	NE																				
ssa	NG																				
ssa	RW																				
ssa	SD																				
ssa	SL																				
ssa	SN																				

Table B.1 (cont.)

		Birth decade																			
		18..									19..										20
World	Country Iso-Code	10	20	30	40	50	60	70	80	90	00	10	20	30	40	50	60	70	80	90	00
ssa	SO								■	■	■	■	■	■							■
ssa	SZ													■		■	■	■	■		
ssa	TD							■	■	■	■		■	■		■	■	■	■		■
ssa	TG						■				■		■			■	■	■	■	■	
ssa	TZ							■	■	■		■	■	■	■	■	■	■	■	■	
ssa	UG							■	■	■		■	■	■		■	■	■	■	■	■
ssa	ZA									■	■	■	■	■	■	■	■	■	■	■	
ssa	ZM														■	■	■	■	■	■	■
ssa	ZW									■	■					■	■	■	■	■	
wee	AT		■	■	■	■	■	■	■	■	■	■	■				■	■	■		
wee	BE	■	■	■	■	■	■	■			■				■		■				
wee	CH		■	■				■	■	■	■	■	■	■							
wee	CY						■	■	■	■											
wee	DE	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■		
wee	DK		■	■		■	■	■	■	■	■	■	■	■	■	■	■	■	■		
wee	ES			■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■		
wee	FI	■	■	■			■				■	■	■	■	■	■	■	■	■		
wee	FR	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■		
wee	GR							■	■		■	■	■	■	■	■	■		■		
wee	IE	■	■	■	■			■	■	■	■		■	■		■	■	■	■		
wee	IT	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■		
wee	NL	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■		
wee	NO	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■		
wee	PT	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■		
wee	SE			■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■		
wee	UK	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■		

Note: Migrant heights (unadjusted), with the number of birth decades in parentheses, was used in the following countries: Algeria (2), Armenia (1), Bangladesh (4), Croatia (Hrvatska) (1), Czech Republic (1), India (6), Israel (1), Korea (North) (6), Malawi (1), Mozambique (1), Pakistan (1), Poland (2), Romania (1). Source: Baten and Blum (2012).”men” denotes countries from the middle East and North Africa. The group “naa” includes North America, Australia and New Zealand.

Figure B.1: The probability of onset of civil war subject to democracy

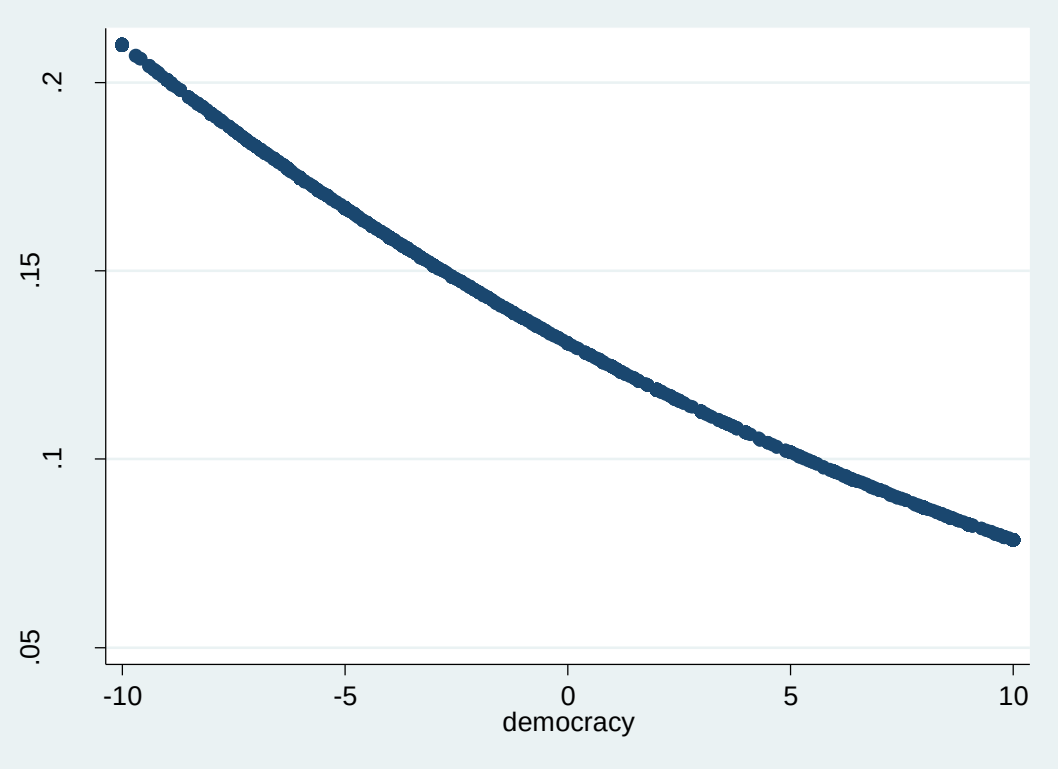


Table B.2: Multicollinearity statistics. variance inflation factors for the independent variables and correlation between height inequality and lagged average height

Variable	VIF	1/VIF
Inequality	1.17	0.855
Lag height	1.45	0.689
Democracy	1.40	0.717
$(\text{Democracy})^2$	1.51	0.663
Population (logs)	1.31	0.765
Ethnic polarisation	1.17	0.856
Colony	1.16	0.862
Diamond mining	1.18	0.845
Mean VIF	1.29	

	Lag height	Inequality
Lag height	1	
Inequality	-0.045	1

Table B.3: Horserace between inequality and lagged inequality

	(1)
	Panel Logit
Inequality	0.041
	(0.143)
Inequality t-1	0.040*
	(0.094)
Height	-0.464
	(0.173)
Population (log)	0.013
	(0.172)
Peace Duration	-0.002
	(0.302)
Colony	-0.023
	(0.431)
Time dummies?	Yes
N	454
Chi-squared	101.7

Notes: * significant on the 10% level.

Table B.4: Within- and between variation of variables

Variable		Mean	Std. dev
Onset of civil war	Overall	0.07	0.25
	Between		0.10
	Within		0.23
Inequality	Overall	3.77	0.37
	Between		0.28
	Within		0.27
Height	Overall	1.68	0.05
	Between		0.03
	Within		0.03
Democracy	Overall	-0.01	0.07
	Between		0.05
	Within		0.05
Democracy^2	Overall	0.45	0.35
	Between		0.23
	Within		0.27
Colony	Overall	0.22	0.41
	Between		0.26
	Within		0.32
Diamond	Overall	0.13	0.34
	Between		0.34
	Within		0.00
Ethn. Fract	Overall	0.46	0.26
	Between		0.26
	Within		0.00
Population (logs)	Overall	7.86	1.84
	Between		1.67
	Within		0.80

Table B.5: Robustness test of the results on ethnic fractionalisation. Comparison of fractionalisation measures.

	(1)	(2)	(3)
Marg. Effects?	Y	Y	Y
Inequality	0.054*	0.049*	0.052*
	(0.053)	(0.062)	(0.066)
Height	-0.607**	-0.429	-0.574*
	(0.047)	(0.116)	(0.076)
Peace duration	-0.005	-0.006*	-0.004
	(0.162)	(0.098)	(0.215)
Ethn. Fractionalisation	-0.075		
	(0.216)		
Language Fract.		-0.034	
		(0.523)	
Religious Fract.			-0.000
			(0.996)
Time dummies?	Y	Y	Y
Wreg dummies?	Y	Y	Y
N	637	632	643
Log lik.			
Chi-squared	153.0	154.	142.9

Notes: This table includes solely our deprivation variables and different fractionalisation measures. As fractionalisation has been mentioned as one of the main drivers of civil wars in the previous literature on civil wars, we introduce ethnic fractionalisation, ethno-linguistic fractionalisation and religious fractionalisation separately to assess whether perhaps fractionalisation rather than deprivation is the actual driver of a conflict, or whether the deprivation coefficients change dramatically if we include fractionalisation measures. As a result, fractionalisation does not turn significant in any of the specifications in our long-run study. Heteroskedasticity-robust clustered standard errors applied in every model. P-values in parentheses, ***, **, * significant on the 1, 5, and 10%-level respectively. Inequality is proxied by height cv, absolute deprivation is proxied by height, both lagged by one decade. Peace duration: sequence of decades where no war has started up to the current period. Other notes: see Table 3.3.

4. How effective is development aid? Human stature as a new indicator in a core debate.

Abstract

How can we assess development aid effectiveness? Previous studies mostly used GDP per capita growth to assess whether aid has welfare enhancing effects, although the problems of this measure for developing country performance – especially during the 1960s to 1980s – is well-known. We argue that indicators related to human stature are reliable indicators that can complement our abilities to measure aid outcomes, as they are directly linked to malnutrition and are often available for countries for which GDP data is missing. We find that development aid had significantly negative effects on well-being in the short-run during the 1960s to late-1970s while the impact was still negative but not significantly so during later periods. In the long-run, however, higher aid flows seem to be positively related to well-being outcomes, although this effect is mostly insignificant.

This chapter is based on a paper by Mumme and Baten (2013). The concept of the paper was jointly developed, the empirical analysis and the writing was equally shared.

4.1 Introduction

Can the rich West help the less developed world? During the past decades, developed countries have tried to advance the development process of poorer nations by transferring a part of their income and wealth via development aid. But the question whether the attempts to help poor countries have been fruitful still remains unresolved. Mixed results have been reported by existing studies. Many individual initiatives have been assessed and found to have been beneficial. However, studies that assessed the effect of foreign aid on GDP growth have yielded mostly disappointing results: either the effect of aid was found to be insignificant, or even negative (Boone 1996; Rajan and Subramanian 2008, among others). New hope with regard to the effectiveness of aid policies arose with a study by Burnside and Dollar (2000) who argued that aid per se might not lead to beneficial outcomes, but aid given to countries with good institutions does in fact result in growth. The initial euphoria caused by these results diminished as an extension to this study found that Burnside and Dollar's positive results became insignificant once the data set was expanded in years and countries (Easterly et al. 2004). Other studies showed that the aid effectiveness rather depends on the donor than the recipient: developmental aid – defined as aid provided by donors who are known to give aid for developmental instead of political motives – had a large and significant positive impact on long-run growth (Minoiu and Reddy 2010).

While there is a substantial – yet controversially discussed – literature regarding foreign aid's impact on growth, studies analysing aid's effect on alternative indicators of well-being remain scarce. However, an assessment of aid effectiveness with regard to non-monetary development outcomes is particularly necessary considering that countries with rapid GDP growth do not necessarily experience increasing standards of living. Oil exporting countries such as recently Angola or Gabon, for example, achieved high GDP growth rates without significantly improving the general well-being.[59] Hence, the effects of development aid need to be studied using a broader set of living standard indicators. In the present study, we argue that indicators determined by the fulfilment of basic human needs – such as nutrition and healthcare – can help to put the aid

[59] The phenomenon of declining biological well-being in times of economic prosperity, also known as the *antebellum puzzle*, have been extensively studied by Komlos, see for example Komlos (1996, 2012).

effectiveness debate into a broader and more development-oriented context. Examples for such indicators are human stature, stunting or weight.

Malnutrition is one of the severe problems in the developing world. People in poor countries are confronted with a bad disease environment and lacking access to medical treatment and clean water. In addition, developing countries are faced with frequent natural disasters that lead to increases in food prices and several other issues that negatively affect living and health standards. Donors and recipient countries have pinned their hopes on foreign aid to ease poverty and hardship in general and the above mentioned difficulties in particular.

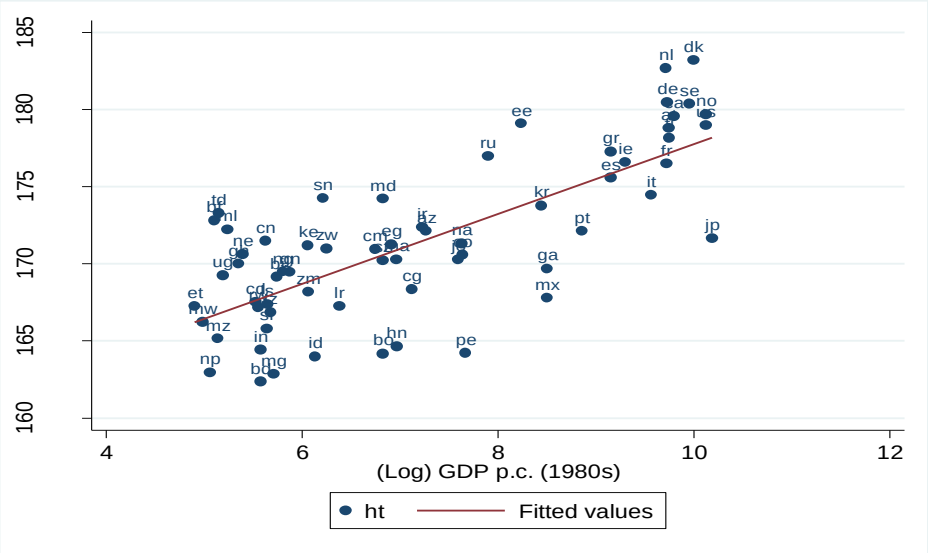
The objective of our study is to analyse whether foreign aid does fulfil these expectations and actually leads to improved well-being in developing countries.[60] We introduce adult height – using a comprehensive and new data set on height as a proxy for human well-being – and stunting of children as indicators of well-being to this debate. Although anthropometric indicators can behave completely different from monetary aspects of well-being in certain periods of time (Komlos 1996, 1997, 1998, 2012), average height is often closely correlated with these indicators (see Figure 4.1).

Particularly for earlier periods, this allows researchers to overcome the problem of missing data they are faced with if indicators of welfare are not available for some very poor countries; said countries are more likely to receive aid but less likely to collect data on well-being. Moradi (2010), for example, shows that anthropometric indicators provide a very good picture of the nutritional status and health of people living in Sub-Saharan Africa. These indicators are strongly influenced by food availability (with proteins playing a major role), the disease environment and access to medical treatment. This is why average height is also very closely correlated with composite measures of well-being, such as the Human Development Index (Figure 4.2).

Of course, the factors outlined above do not represent a full list of parameters that might affect our health indicators. Factors such as natural disasters, the quality of infrastructure (which is needed to be able to reach the next hospital or market), income,

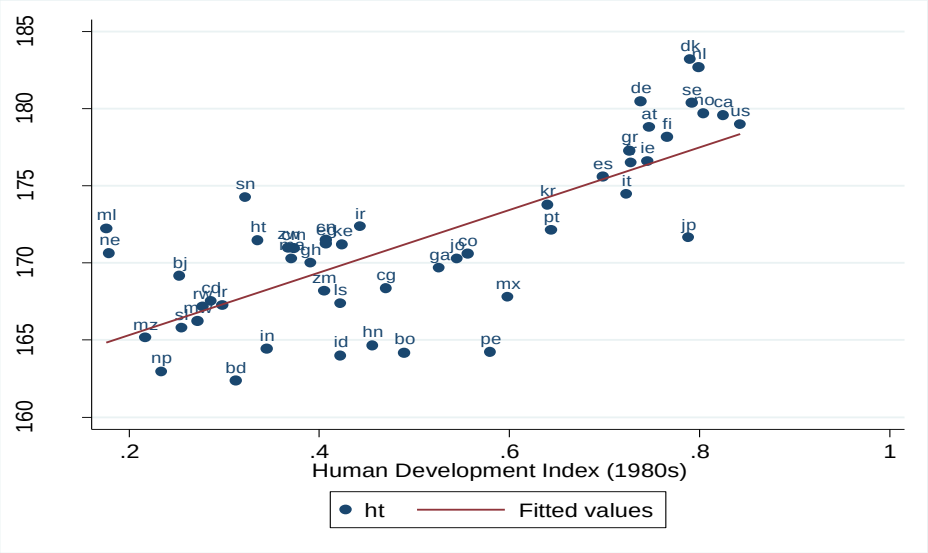
[60] A few studies that try to address the same question exist, but the authors rather consider the impact of health aid on infant mortality, which will be discussed below.

Figure 4.1: The relationship between average adult height and the GDP per capita (in logs) in the 1980s



Notes: For the purpose of improved clarity, we only took data points from one decade, the 1980s. Source of the GDP data: World Bank Indicators, http://data.worldbank.org/indicator. Source of height data as described in the appendix

Figure 4.2: The relationship between average adult height and the Human Development Index in the 1980s



Notes: For the purpose of improved clarity, we only took data points from one decade, the 1980s. Source of the Human Development Index data: United Nations Development Programme homepage, http://hdrstats.undp.org/en/indicators/103106.html. Source of height data as described in the appendix.

the agricultural structure and productivity also play a major role.[61]

We will also assess the long-term effects of foreign aid on well-being as we suspect that it takes a while until project initiatives are effectively implemented and finally lead to measurable responses in anthropometric values. The article is organised as follows. Section 4.2 reviews the aid effectiveness literature that focuses on aid's impact on well-being. We will then discuss our data and the method of estimation in the subsequent two sections and present our results in section 4.5. The article closes with concluding remarks.

4.2 Literature review

While there is an abundant literature on the effects of aid on GDP growth, few studies address the impact of aid on well-being and health, with rather mixed results. Boone (1996) finds no evidence for positive impacts of aid on human development measures, such as infant mortality or primary schooling. Moreover, his results show that the impact of aid does not vary according to whether it is given to a more democratic or repressive regime. This is in line with Wilson's (2011) finding for health-specific aid, showing that aid is generally given to countries with declining mortality, but it does not generate a decline in mortality. However, he finds some evidence that spending on HIV and infectious diseases yielded statistically significant – though modest – effects on mortality. The results of studies analysing the impact of foreign aid on infant mortality are rather mixed: while some authors do not find any impact of aid on infant mortality (Williamson 2008), others show that infant mortality can be significantly reduced by providing foreign aid (Mishra and Newhouse 2007; Gomanee et al. 2005). Masud and Yontcheva (2005) provide evidence that aid is only effective in reducing infant mortality if it is provided by an NGO, while bilateral aid flows to the recipients' governments do not have significant impacts on mortality, according to their results. The latter finding is particularly interesting as it indicates that NGO aid – which is assumed to be development-oriented – is more effective in improving recipients' lives

[61] This is the fundamental reason for using overall aid instead of sector-specific aid in this study, which will be explained in more detail in section 4.4.

than bilateral aid, which is supposed to be motivated by political reasons. This should be considered when empirically assessing aid's effectiveness. Finally, no significant impact of aid has been found for different health indicators, such as life expectancy, death rates and immunisations (Williamson 2008).

Other studies assess the effectiveness of aid on the country or continent level instead of providing a global view. Batana (2010) has done so for ten Sub-Saharan African countries and observes welfare improvements in seven of them since the 1990s. However, the author points out that the amount of aid provided or the degree of government effectiveness do not seem to have been the major driving-forces of these developments. In the Ethiopian case, food aid was found to have increased child growth in the mid-1990s (Yamano et al. 2005). A case study for 3,000 Indonesian villages shows that recipients of incentivised aid – meaning that a better health performance of the village relative to other villages led to higher grants in the future – had better health outcomes than villages receiving non-incentivised aid (Olken et al. 2010). This finding can be considered as an important contribution to the aid effectiveness debate, as it indicates that aid *can* help, but the effectiveness depends on the way how aid is given.

In summary, empirical evidence with regard to the effects of foreign aid on human well-being is mixed. In the light of the results of previous studies, we will take into consideration various potentially influential factors and challenges, such as endogeneity issues, donor-specific interests and the fungibility of aid. Last but not least, we also focus on the long-term impacts of aid.

4.3 Data

We divide our empirical study into two time periods, hereafter referred to as the "early period" and the "later period". The research on the early period analyses the impact of aid flows provided between 1960 and 1979 on anthropometric outcomes in the subsequent period. The later period examines the effects of foreign aid provided between the early-1980s and late-2000s. The first period is particularly interesting because many authors who discuss the effectiveness of aid in improving well-being only look at later periods, as data on conventional indicators are often scarce or

unreliable in the case of particularly poor countries between the 1960s and early-1980s. Using the new and very comprehensive data set on human stature provided by Baten and Blum (2012) allows us to look at the change in average height from one decade to another, taking into account individuals born between the 1960s and 1980s. We can therefore assess the improvement or deterioration in health standards by using anthropometric data organised by birth decade, including countries for which conventional indicators are often not available for the early period.[62] For instance, the data set provides an extensive coverage of African countries. To sum up, we use the change of mean adult height of people born during a certain birth decade compared to people born in the subsequent decade as a dependent variable for the early period: $[(height_{t+1} – height_t) / height_t]*100$. As heights are mostly determined by the living conditions during the first years of life, we organise all evidence by birth cohort. Looking at changes in countries and periods with high or low aid intensities, we can test whether foreign aid actually led to an improvement in a population's living conditions.

We use a quite similar indicator as dependent variable for the later period, namely the change in the proportion of children that are not stunted: (% children not $stunted_{t+1}$ – % children not $stunted_t$)*100.[63] Since there is more data available from the 1980s onwards, we can organise this data in 4-year periods, as it has often been done in other studies on aid effectiveness.[64]

Why is it necessary to use different dependent variables for the two periods at all? First of all, limited data on stunting of children are available until the 1980s, which is particularly true for poor countries. However, these are the countries we are most interested in, as poor countries are expected to receive more aid (if we assume aid to be given for the purpose of alleviating poverty and not for fostering political relationships).

[62] We could also take the absolute average height of a population as dependent variable, as the *average* human height of a population group is not influenced by genetics as long as the composition of the population is not altered through large-scale migration. Changes in height, however, are often taken to rule out any possible influences stemming from genetics as they are not affected by genetic factors (Komlos 1994). To make the dependent variables of the later period more easily comparable to the change in height, we also use changes instead of absolute values here.

[63] For children up to two years of age height is measured by recumbent length. For older children height is measured by stature while standing. The data are based on the WHO's new child growth standards released in 2006.

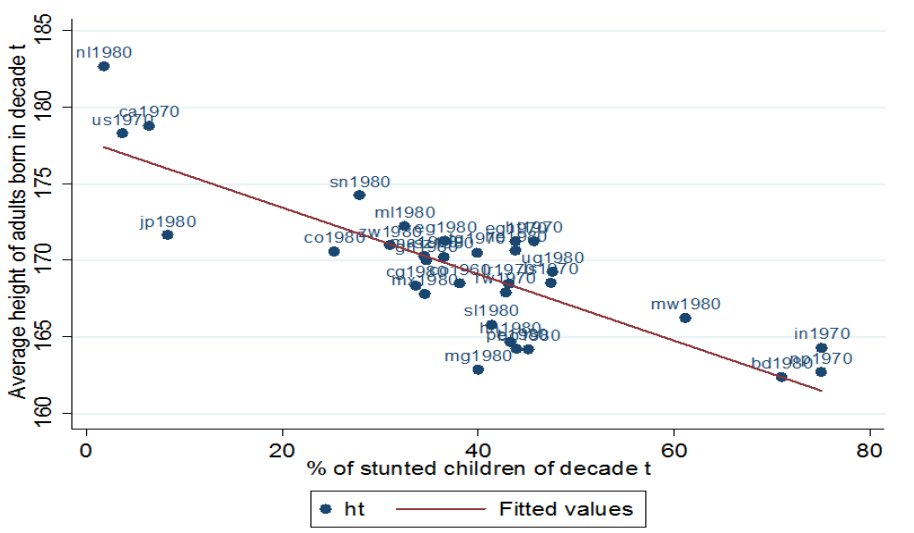
[64] We assume that it generally takes some years until aid flows actually have a visible effect because investments in infrastructure, health care etc. can hardly be undertaken immediately.

Using the comprehensive data set on adult height by Baten and Blum (2012) for the early period has the advantage that it also contains abundant information on countries for which data on well-being are relatively scarce or not available at all. In addition, this data set has been carefully checked for sample selectivity bias (SSB), as this issue has been quite intensively discussed in the recent height literature.[65] We cannot use this height data set for the later period, though, given that there are obviously no data on mean *adult* height for this period yet (as people born in this period are not yet adults). Luckily, the WHO data on child stunting is very comprehensive for the later period. The percentage of stunted children according to the WHO definition is calculated by measuring the percentage of children under the age of 5 whose height for age (stunting) is more than two standard deviations below the median for the international reference population aged 0-59 months. Figure 4.3 shows that there is a strong correlation between adult height and stunting (with a correlation coefficient of -0.8224) for the countries and time periods in which data for both indicators were available, therefore we can assume that our dependent variables for the earlier and the later period reflect the same underlying fundamentals.

Furthermore, it might be an advantage to analyse the two periods separately, because the foreign aid policy design changed at the beginning of the 1980s. While 52 per cent of total OECD aid in the mid-1970s consisted of aid given for a specific purpose (project aid), aid was shifted to programme aid (aid given for a specific sector) on an increasing scale since the beginning of the 1980s (Mosley and Eeckout 2000, pp.132 ff.). Dividing our research into two periods where different policy approaches prevailed might enable us to see which policy approach is more effective. Mishra and Newhouse's (2007) findings that aid became more effective since the 1990s, especially in countries with high quality institutions, might already be an indication that programme aid led to more favourable developmental outcomes.

[65] Especially sample selectivity bias of data sets based on voluntary army records have been the topic of this debate. However, the observations on developing countries included here are exclusively based on systematic and representative measurements by anthropologists and health projects.

Figure 4.3: The relationship between average adult height and child stunting for several countries during the 1970s to 1980s.



Notes: Data points reflect those countries and time periods where data on both stunting and average height does exist and are labelled with the country's ISO-code and the relevant decade. Data on stunting was extracted from the World Bank, http://data.worldbank.org/indicator. Source of height data as described in the appendix.

The data on net official development assistance was taken from the Development Assistance Committee (DAC) data set of the Organisation for Economic Co-operation and Development. The data set contains information on commitments and disbursements by recipient and type since the 1960s.[66] While most studies on aid effectiveness use data on donor commitments, donor disbursement data are used in this study. Disbursements are more exact measures of the funds that have been transferred to the recipient because commitment data generally overstate the amount of aid that was actually paid during a certain period. The net official development assistance is the difference between the value of aid received by a country and the principal repayments of received loans and return of unspent balances. The sources and definitions of other explanatory variables used in the empirical analysis are provided in the appendix.

[66] While commitments are recorded in the full amount of the expected transfer, irrespective of the time required for the completion of disbursement, disbursements are the actual funds that have been transferred to a recipient. It can take several years until a commitment has been disbursed (www.oecd.org/dac/glossary).

4.4 Estimation strategy

In our study, we assess the impact of foreign aid on height growth and change in child stunting, using several robustness tests and instrumental variable techniques to control for potential endogeneity. In this chapter, we use overall aid to avoid potential crowding out effects that often arise in poor countries receiving sector-specific aid. More specifically, Fielding (2008, p. 2 ff.) argues that if aid is in general fungible, then the government who receives health-specific aid might reduce government spending on health (as this sector is now supported by foreign aid) and increase expenditures in other areas instead. The author therefore suggests to model total aid expenditure rather than sector-specific aid if fungibility is likely to exist. Furthermore, improved nutrition and health might be related to investments in other sectors, such as infrastructure (which is needed to be able to reach the next hospital or market) or agriculture. We therefore respond to these concerns by taking a look at the effects of overall aid in this paper. The effects of sector-specific aid, more specifically: food aid, will be analysed individually in the subsequent chapters.

We test the impact of foreign aid on well-being with different identification strategies. In every specification we average our data to ten-year periods for the 1960s to 1970s[67] and to 4-year periods for the later period to reduce measurement errors and annual fluctuations.[68] We then use different types of models to test our assumption that foreign aid increases well-being outcomes. In a first step, we use ordinary least squares as well as GLS random-effects and fixed effects models.[69]

We then apply two-stage least-squares (2SLS) models to take into account the potential endogeneity of the aid variable. Endogeneity has been widely addressed in the literature as it is assumed that more aid is generally given to countries that are worse off, either in monetary terms or in terms of the biological standard of living. In a

[67] More specifically, we estimate how aid flows during the 1960s and 1970s affect height growth from the current to the subsequent period.

[68] If we used 4-year periods, as it is usually done in the aid effectiveness literature, and applied our dependent variable for the later period in all the cases, we would only obtain one observation for the period 1966-1970, 15 for the period starting in 1978, but already 97 observations for the period 1998-2001.

[69] While random effects are the preferred model for the early period, the fixed effects model is the better model for the later period according to the Hausman test.

nutshell, while aid might influence the well-being of recipients, the latter might just as well be a determinant of the amount of aid received. We tackle the problem of potential endogeneity by using two-stage least squares models, which is the most frequent approach to dealing with endogeneity in the aid effectiveness literature.[70] Although our F- statistics on the excluded instruments pass the critical threshold of 10 (Stock et al. 2002), we also introduce a limited information maximum likelihood (LIML) in some cases. Angrist and Pischke (2009, pp.209) recommend to use LIML when instruments are rather weak and to check overidentified 2SLS with LIML, as the bias in 2SLS results increases with the number of instruments and LIML estimates render less biased results.

The set of instrumental variables implemented here has already been widely used in the aid effectiveness literature (Burnside and Dollar 2000, among others). It addresses special relationships between donors and recipients. More specifically, we use a "*French*"-dummy as it has been found that French-speaking countries – particularly former French colonies – receive more aid from their former coloniser. Furthermore, we use dummies for *Egypt* and *Central America*, given the special interest of the United States in these countries. As small nations have been found to receive relatively large amounts of aid as donors expect to be able to have a stronger political influence on them, *population* (in logs) also enters as an instrumental variable.

The basic equation looks as follows:

$$\Delta ht_{i,t} = \alpha + ß_1\, aid_{i,t} + ß_2\, ht_{i,t} + BX + \eta_t + u_{it}$$

where Δht represents the height growth from period t to period (t+1) for the earlier period and the change in the percentage of children who are not suffering from stunting from period t to period (t+1) for the later period. Aid is the share of average official development assistance to GDP in period t and country i (expressed as a fraction between 0 and 1). η_t represents time fixed effects, while u_{it} is the disturbance term. In addition, $ht_{i,t}$ is the mean height of the population in country i during period t for the early period or the percentage of children that were *not* stunted in period t for the later

[70] GMM models have been tested. However, applying GMM procedures led to a sharp reduction in the number of observations.

period, respectively. This variable accounts for the effect that countries with relatively high levels of well-being in the past are likely to experience less catch-up growth in following periods. We therefore expect the coefficients to be negative.

We also controlled for a variety of other exogenous factors in our regressions, represented by the vector X. For example, we introduce ethnic fractionalisation scores that range between 0 and 1, as fractionalisation has regularly been included as a variable controlling for institutional quality in the aid effectiveness literature. As civil strives severely affect the nutritional situation in a country, we include a dummy variable that takes on the value 1 if an intra-state war took place in country i during period t. We expect civil unrest to increase malnutrition and therefore negatively affect our dependent variable. The political regime is controlled for by including a commonly-used political participation indicator constructed by the Polity IV project.[71] To capture the effects of the health environment and access to medical treatment on heights and well-being per se, we control for the number of physicians per 1,000 people. We implement a Sub-Saharan Africa dummy, because this part of the world is known to suffer from a particularly bad disease environment, high HIV rates, a significant number of natural catastrophes and other circumstances that negatively affect our dependent variable. As openness to trade is an indicator that relates good polies and a favourable trade environment, which might also positively affect well-being outcomes, we include the openness indicator by Sachs and Warner (1995).[72]

Most of the aid studies so far have only analysed the short-term effects of aid, indirectly assuming that aid received today will have a measurable effect in the near future. In our study, we take into account the possibility that it takes a rather long period, maybe even decades, until aid effects become visible. More specifically, it takes a while to implement measures to improve health and nutrition. The construction of hospitals, the education of doctors or the implementation of agricultural reforms are only a small selection of examples for projects that will only become effective after a

[71] The original polity4 variable is coded between -10 (complete autocracy) and +10 (democracy). We ran a linear transformation and recoded the variable between 0 and 20, where 20 is a completely democratic country.

[72] Baltzer and Baten (2008) also find that highly unequal societies have a tendency to *close* the economy. On the issue of height inequality, see also Blum (2013; 2014).

certain amount of years. In this case, merely looking at short-term achievements might understate the actual effectiveness of foreign assistance. For instance, Minoiu and Reddy (2010) find that a one per cent increase in the average bilateral Aid/GDP ratio given by a particular donor group (Netherlands and Scandinavian countries) between 1960 to 1990 increased per capita GDP growth rates by 1.2 to 1.3 percentage points in the 1990s. Against this background, we find it reasonable to complement the short-term results with a long-term perspective of aid effectiveness. We therefore analyse the effect of mean and total aid transfers during the 1960s to 1980s on stunting in the 1990s to 2000s.

We also take potential multicollinearity issues into consideration. Although our calculated variance inflation factors do not indicate a multicollinearity problem, we avoid including variables that appear to be too closely connected simultaneously. For instance, we do not include the number of physicians and the infant mortality rate or initial GDP p.c. and initial height at the same time, as these factors might be strongly correlated.

4.5 Estimation results

In a first step, aid is considered to be exogenous. This allows us to obtain baseline estimates which can later be compared with two-stage least square estimates. In a first step, we use ordinary least squares as well as fixed effects and random effects models (Table 4.1). The results show that an increase in Aid/GDP in the 1960s to 1970s period leads to a significant decrease in height growth. This result stays significant both in the random effects model[73] and the fixed effects model, although the coefficient increases in size in the latter model. For the later period, the sign of the aid coefficients is negative, except for the fixed effects model – which is, according to the Hausman test, the preferred model[74] – but insignificant in all cases (column 4-6 of Table 4.1).

[73] According to the Hausman test, the random effects model is the preferred model for the early period (p-val.: 0.42). However, it is generally reasonable and accepted to use fixed effects in cross-country studies.
[74] The p-value of the Hausman test is 0.017.

Table 4.1: Determinants of height growth: short- term aid effectiveness
(Ordinary least squares, random effects and fixed effects regressions)

	(1)	(2)	(3)	(4)	(5)	(6)
	OLS	FE	RE	OLS	FE	RE
		1960s to late 1970			1980s to late 2000s	
Aid	-0.15***	-0.22**	-0.15***	-0.12	0.99	-0.19
	(0.00)	(0.01)	(0.00)	(0.71)	(0.47)	(0.58)
Initial height	0.04***	-0.17	0.04***			
	(0.01)	(0.11)	(0.01)			
Initial non-stunted				-0.14***	-0.54***	-0.20***
				(0.00)	(0.00)	(0.00)
Ethnic fractionalisation	0.37**		0.41***	1.03		0.77
	(0.01)		(0.01)	(0.63)		(0.74)
Intra-state war	-0.17**	-0.14	-0.19***	1.56	1.11	1.75
	(0.02)	(0.19)	(0.00)	(0.37)	(0.74)	(0.35)
Democracy	0.01	0.04*	0.01**	-0.07	0.39**	-0.06
	(0.12)	(0.09)	(0.04)	(0.29)	(0.05)	(0.46)
Physicians (log)	-0.07	-0.26	-0.08*	0.50	2.81	0.91
	(0.13)	(0.20)	(0.09)	(0.37)	(0.20)	(0.16)
SSA	-0.79***		-0.84***	-1.94		-1.57
	(0.00)		(0.00)	(0.29)		(0.42)
Openness	0.04	-0.02	0.04	1.04	-2.19	0.77
	(0.67)	(0.88)	(0.61)	(0.58)	(0.23)	(0.67)
Constant	-6.46***	27.58	-6.49***	10.16**	41.56***	14.94***
	(0.01)	(0.12)	(0.00)	(0.02)	(0.00)	(0.01)
# groups		39	39		75	75
Time FE?	Yes	Yes	Yes	Yes	Yes	Yes
N	68	68	68	141	141	141
R2	0.66	0.41		0.19	0.40	
Hausman p-val.		0.423			0.02	

Note: P-values in parenthesis, ***, **, * significant on the 1, 5, and 10%-level respectively. (Country-) cluster robust standard errors applied in every model.

The results for the later period show that countries with an already generally high level of well-being– measured by the percentage of children that are not stunted – are less likely to experience further large improvements: the respective coefficient is negative and significant. Intra-state wars and Sub-Saharan Africa are significantly and negatively correlated with height growth in the early period, while democracy has mostly positive effects in both periods. The density of physicians does not greatly affect height growth, the coefficient only turns negative and significant in the random effects model of the early period. This might be caused by the fact that countries with a high number of physicians per capita already have high average height levels and therefore experience less catch-up growth. Similar regressions with infant mortality rates instead of physician density[75] show that high infant mortality rates were significantly and negatively correlated with our dependent variable. Consequently, we conclude that a good health environment generally has a positive influence on height growth and on the reduction of undernourishment.

In the following, we use two-stage least-squares regressions and limited information maximum likelihood models to circumvent the endogeneity issue (Table 4.2 for the early period and Table 4.3 for the later period). For the early period, foreign aid stays negative and significant in the IV specification. More specifically, a one standard deviation increase in Aid/GDP implies a decrease in height growth by between 0.128 and 0.827 per cent, the latter if country fixed effects are introduced.[76] As average initial height was 168.8, this corresponds to a height decline of between 0.48 and 1.40 cm – per decade (!). Komlos and Baten (1998b) estimated that one centimetre of height corresponds with 1.2 years of life expectancy, hence this amount is not negligible. If we express this in standard deviations of the dependent variable, we arrive at 0.65 and 0.92 standard deviations, i.e. between two thirds and more than 90 per cent of its standard deviation. This is clearly a substantial size.[77]

[75] Not reported here, but available from the authors.
[76] The size of the coefficient increases once we introduce fixed effects or an interaction term of aid and political rights, however, the number of observations also decreases dramatically in the latter case.
[77] (0.23*1.25)/0.44 for model 1 of table 4.2 and (0.66*1.25)/0.44 for model 5 of table 4.2. 1.25 is the standard deviation of log (Aid/GDP), 0.44 is the standard deviation of the dependent variable.

Table 4.2: Determinants of height growth: short- term aid effectiveness (2SLS and LIML for the 1960s – late 1970s period)

	(1) 2SLS	(2) LIML	(3) 2SLS	(4) 2SLS	(5) 2SLS FE
Aid	-0.23***	-0.23***	-0.32*	-0.29*	-0.66***
	(0.00)	(0.00)	(0.08)	(0.05)	(0.00)
Initial height	0.04***	0.04***	0.04***		-0.57**
	(0.00)	(0.00)	(0.00)		(0.03)
Ethnic fractionalisation	0.37**	0.37*	0.21	0.12	
	(0.05)	(0.05)	(0.59)	(0.67)	
Intra-state war	-0.22***	-0.22***	-0.36***	-0.21**	-0.20
	(0.01)	(0.01)	(0.00)	(0.04)	(0.24)
Openness	0.11	0.11	0.43**	0.04	-0.19
	(0.21)	(0.20)	(0.01)	(0.72)	(0.35)
Democracy	0.01	0.01	0.00	-0.01	0.09**
	(0.14)	(0.15)	(0.88)	(0.52)	(0.02)
Physicians (log)	-0.11**	-0.11**	-0.11**		
	(0.02)	(0.02)	(0.01)		
Sub-Saharan Africa	-0.79***	-0.79***	-0.66**	-0.49***	
	(0.00)	(0.00)	(0.02)	(0.00)	
Aid*political rights			0.02		
			(0.42)		
Infant mortality (log)				-0.02	-1.11**
				(0.93)	(0.02)
Initial GDP p.c.				-0.07	
				(0.48)	
N	68	68	31	59	58
Time FE?	Yes	Yes	Yes	Yes	Yes
Country FE?	No	No	No	No	Yes
Kleibergen-Paap p-val.	0.13	0.13	0.43	0.10	0.04
Anderson Rubin p-val	0.00	0.00	0.00	0.12	0.00
Hansen p-val	0.55	0.55	0.10	0.14	ex.id.
No. of clusters	39	39	31	34	29
F aid	7.10	7.10	14.94	3.59	11.63
F aid*pol. rights			7.94		
Wu-Hausman	0.04		0.90	0.12	
Davidson-MacKinnon					0.03

Notes: P-values in parenthesis, ***, **, * significant on the 1, 5, and 10%-level respectively. Heteroskedasticity-robust (country-) clustered standard errors applied in every model. Anderson Rubin p-val. is the p-value of the Anderson Rubin Chi-squared test.

Table 4.3: Determinants of (non-) stunting: short- term aid effectiveness (2SLS and LIML for the 1980s – late 2000s period)

	(1) 2SLS	(2) LIML	(3) 2SLS	(4) LIML
Aid	-0.26	-0.28	-0.01	-1.21
	(0.65)	(0.66)	(0.98)	(0.76)
Initial non-stunted	-0.15***	-0.15***		-0.20***
	(0.00)	(0.00)		(0.00)
Ethnic fractionalisation.	0.91	0.89	0.76	1.56
	(0.64)	(0.65)	(0.71)	(0.49)
Intra-state war	1.45	1.43	0.34	0.58
	(0.37)	(0.38)	(0.84)	(0.74)
Openness	1.05	1.05	0.66	0.48
	(0.56)	(0.56)	(0.74)	(0.81)
Democracy	-0.07	-0.07	-0.08	-0.39
	(0.26)	(0.26)	(0.23)	(0.62)
Physicians (log)	0.47	0.46		
	(0.38)	(0.38)		
Sub-Saharan Africa	-1.80	-1.78	-3.62***	-3.20
	(0.31)	(0.31)	(0.01)	(0.11)
Aid*political rights				0.34
				(0.66)
Infant mortality. (log)			-0.93	-2.84
			(0.52)	(0.35)
Initial GDP p.c.				-0.07
				(0.48)
N	141	141	146	165
Time FE?	Yes	Yes	Yes	Yes
Country FE?	No	No	No	No
Kleibergen-Paap p-val.	0.01	0.01	0.00	0.13
Anderson Rubin p-val	0.06	0.06	0.53	0.31
Hansen p-val	0.37	0.37	0.28	0.58
No. of clusters	75	75	70	78
F aid	11.95	11.95	44.89	5.78
F aid*pol. rights				0.63
Wu-Hausman	0.81		0.69	0.53

Note: P-values in parenthesis, ***, **, * significant on the 1, 5, and 10%-level respectively. Cluster-robust standard errors applied in every model. KP p-val. is the p-value of the Kleibergen- Paap statistic, while AR p-val. is the p-value of the Anderson Rubin Chi-squared test.

Our first-stage F-statistics suggest that we might have a weak instruments problem in some of the specifications, as they do not pass the rule of thumb of a first-stage F-statistic greater than 10 as suggested by Stock et al. (2002). Weak instruments might lead to biased estimators and may increase the risk of unreliable test results. In such a case, Fuller's limited information maximum likelihood estimates render more robust estimators. The coefficients of the LIML specifications are indeed slightly bigger than the 2SLS coefficients, but foreign aid provided during the 1960s and 1970s stays significantly and negatively correlated with height growth.

The consistently significant negative impact of aid on height growth implies that foreign aid was not effective or did indeed worsen the situation in poor countries in the early observation period. We should keep in mind that during the 1960s to 1970s project aid was the major instrument of development aid, meaning that money was spent on specific projects, such as constructing a specific school in a certain area. This type of aid is criticised for merely evoking local results, having high transaction costs and ignoring structural and systemic problems in recipient countries (Leiderer 2009). Further issues are the lack of coherence with the recipient country's policies, the lack of transparency and the fact that donors do not use national procedures in the project implementation process, thereby failing to build institutional capacities (Jelovac and Vandeninden 2008). We therefore conclude that the prevailing aid policies of the early period were rather inefficient and therefore failed to increase overall well-being. In other words, positive outcomes of certain projects were probably visible on the local level, but not on the country level.

For the later period, beginning in the early-1980s, our results suggest that foreign aid did not significantly affect well-being. Although the aid coefficients still have a negative sign, they do not turn significant in either of the 2SLS or LIML specifications (Table 4.3).[78] Hence, we conclude that overall aid did neither significantly harm nor improve well-being during the later period: the well-known

[78] Please note that we could not add the fixed effects model and the same set of control variables as in model 4 of table 4.2, as these specifications did not pass our weak instruments test statistics. This would render such a model spurious, as the Hausman test in table 4.1 indicates that country fixed effects should be used for the later period. However, our Wu-Hausman test statistics indicate that aid does not suffer from serious endogeneity and therefore our results from table 4.1 might be a good approximation.

"curse of aid" effects were probably counter-balanced by positive effects of an improved aid design.

All of the above-mentioned results refer to the short-run effects of aid. Considering the relatively negative findings for short-term aid effectiveness, especially during the early period, it is interesting to analyse whether these negative effects can also be found if a long-term view is taken. We use average aid flows (Table 4.4) and the sum of all foreign aid payments (Table 4.5) from 1960 to 1989 to assess how aid flows during this period affect later developmental outcomes.

Our results for the long-term effects of foreign aid show that both average and total aid flows between the 1960s and late-1970s had a positive – although mostly insignificant – impact on well-being. The positive sign remains across OLS and 2SLS specifications and even becomes significant in one case. This result might underline the argument that aid has rather positive effects on well-being in the long-run or, at least, does not do any harm.[79]

We conclude that overall aid did have a negative effect on well-being during the 1960s and 1970s, but a similarly negative impact of aid cannot be confirmed for later periods. In the long run, aid seems to have a positive impact on well-being, although this impact is insignificant in most of the cases.

4.6 Concluding remarks

The objective of this paper was to find out whether overall well-being in a country is significantly affected by official foreign assistance. We contributed to the growing body of aid effectiveness literature by introducing new proxies for well-being, namely height development and changes in the share of stunted children. Our comprehensive height data set enabled us to include countries and periods for which evidence on other human well-being indicators is often lacking or imprecise. This reduces data selectivity problems. We find that development aid had significantly negative effects on well-being in the short-run during the 1960s to 1970s, while the impact was still negative but not significantly so during later periods.

[79] This result is not implausible, as Minoiu and Reddy (2010) found similar effects for GDP growth.

Table 4.4: Determinants of height growth: long-term effects of average aid flows during the 1960s to 1980s on improved well-being in the 1990s and 2000s

	(1) OLS y90-93	(2) OLS y94-97	(3) OLS y98-01	(4) OLS y02-05	(5) 2SLS y90-05
Av. aid6080	0.71	0.16	0.94*	-0.35	0.50
	(0.44)	(0.82)	(0.09)	(0.72)	(0.47)
Initial non-stunted	-0.29**	-0.14**	-0.25***	-0.08	-0.22***
	(0.01)	(0.02)	(0.01)	(0.49)	(0.00)
Democracy	0.05	-0.28**	-0.08	0.11	-0.09
	(0.73)	(0.01)	(0.50)	(0.59)	(0.17)
Ethnic Fract.	6.11	-0.73	0.31	-3.27	1.55
	(0.10)	(0.84)	(0.93)	(0.76)	(0.45)
Inf. Mort. (log)	-6.31**	-3.12	-7.03**	0.97	-4.82***
	(0.05)	(0.22)	(0.01)	(0.74)	(0.00)
SSA	-2.18	-2.97	-0.37	0.35	-1.68
	(0.47)	(0.13)	(0.90)	(0.96)	(0.19)
Openness	-0.33				-0.21
	(0.91)				(0.92)
Period 1994-1997					-0.41
					(0.81)
Period 1998-2001					-0.33
					(0.85)
Period 2002-2005					-1.68
					(0.41)
Constant	46.78**	29.62**	51.07***	2.50	39.21***
	(0.01)	(0.03)	(0.00)	(0.87)	(0.00)
N	29	52	42	22	145
R2	0.37	0.31	0.33	0.11	0.24
Time FE?	Yes	Yes	Yes	Yes	Yes
Country FE?	No	No	No	No	No
Kleibergen-Paap p-val.					0.07
Anderson Rubin Chi2 p-val					0.00
Hansen p-val					0.47
no. Of clusters	29	52	42	22	78
F aid					13.65
Wu-Hausman					0.86

Note: P-values in parenthesis, ***, **, * significant on the 1, 5, and 10%-level respectively. (Country) cluster-robust standard errors applied in every model. KP p-val. is the p-value of the Kleibergen- Paap statistic, while AR p-val. is the p-value of the Anderson Rubin Chi-squared test.

Table 4.5: Determinants of height growth: long-term effects of the total aid flows during the 1960s to 1980s on an improved standard of living in the 1990s and 2000s

	(1) OLS y90-93	(2) OLS y94-97	(3) OLS y98-01	(4) OLS y02-05	(5) 2SLS y90-05
Sum aid6080	0.95	0.19	0.55	0.30	0.16
	(0.15)	(0.81)	(0.22)	(0.83)	(0.82)
Initial non-stunted	-0.22***	-0.20***	-0.22**	-0.10	-0.20***
	(0.00)	(0.01)	(0.02)	(0.44)	(0.00)
Democracy	0.09	-0.29**	-0.08	0.29	-0.08
	(0.43)	(0.04)	(0.51)	(0.29)	(0.26)
Ethnic Fract.	5.08	1.60	-2.24	-4.86	1.40
	(0.15)	(0.67)	(0.60)	(0.68)	(0.43)
Inf. Mort. (log)	-5.85**	-5.70*	-4.62*	0.06	-4.34***
	(0.02)	(0.06)	(0.09)	(0.99)	(0.00)
SSA	-3.86*	-1.44	-0.80	1.98	-1.23
	(0.08)	(0.49)	(0.81)	(0.77)	(0.32)
Openness	-2.59				-1.66
	(0.11)				(0.26)
Period 1994-1997					0.54
					(0.66)
Period1998-2001					0.94
					(0.45)
Period 2002-2005					-0.45
					(0.79)
Constant	39.96***	41.25***	37.82***	5.41	34.40***
	(0.01)	(0.01)	(0.01)	(0.78)	(0.00)
N	27	47	36	20	130
R2	0.45	0.33	0.31	0.19	0.23
Time FE?	Yes	Yes	Yes	Yes	Yes
Country FE?	No	No	No	No	No
Kleibergen-Paap p-val.					0.08
			0.00		
Hansen p-val					0.34
no. Of clusters	27	47	36	20	66
F aid					8.58
Wu-Hausman					0.81

Note: P-values in parenthesis, ***, **, * significant on the 1, 5, and 10%-level respectively. (Country) cluster-robust standard errors applied in every model. KP p-val. is the p-value of the Kleibergen- Paap statistic, while AR p-val. is the p-value of the Anderson Rubin Chi-squared test.

In the long run, however, an increase in aid flows is positively related to well-being outcomes, although this effect is mostly insignificant.

We interpret this change from significantly negative impacts in the early period to neutral short-run effects in the later period as a result of counter-acting forces. On the one hand, development aid leads to a phenomenon that is frequently described as "the curse of foreign aid": transferring resources into a poor country often leads to rent-seeking behaviour. To put it in a nutshell, instead of efficiently investing foreign aid in projects and sectors it was aimed at and thereby enhancing well-being and growth, recipient governments use aid transfers to enrich themselves. On the other hand, foreign aid strategies have improved over time and, furthermore, aid payments became less influenced by power politics: while the political situation during the cold war heavily influenced donors' behaviour in the early period, aid has become more development-oriented over the years. These improvements in the aid design have apparently counter-acted against the adverse effects resulting, for example, from rent-seeking behaviour. However, positive effects were not strong enough to provide a *significant* contribution to the improvement of anthropometric values in the short-run.

In the long-run, the impact of development aid tends to be positive, probably because the effects of investment in education and health are more clearly observable within a larger time frame. However, the effect stays insignificant in most of the specifications and therefore it would be too daring to conclude that aid actually leads to visible effects in a long-run perspective.

The policy implications that we can draw from these results are twofold. First of all, the aid strategies that are followed by donors nowadays, including the shift from project to programme aid, seem to work far better than aid strategies that have been used at the beginning of food aid flows and, therefore, the food aid policies seems to be on a good way. Given that food aid provided since the 1980s has already yielded clearly better short-term results than aid provided in previous decades (or at least adverse effects have been reduced substantially), we can expect that the long-term effects that might not be visible yet are even more promising.

Secondly, the evaluation of the effectiveness of foreign aid should not only be assessed by using indicators of economic prosperity, such as GDP or the growth thereof.

It is rather necessary to use a broader definition of well-being and therefore also introduce indicators that measure the biological well-being of recipient countries. To be able to do so, it is necessary to improve the data base on non-monetary indicators of welfare (for poor countries, in particular).

Appendix C

Table C.1: Countries for which evidence is available in the respective period

1960s to late-1970s	1980s to late 2000s
Benin	Albania
Bolivia	Algeria
Brazil	Angola
Burkina Faso	Armenia
Cameroon	Azerbaijan
Central African Republic	Bangladesh
Chad	Benin
China	Bolivia
Colombia	Botswana
Congo	Burkina Faso
Côte D'Ivoire (Ivory Coast)	Cambodia
Democratic Republic of the Congo	Cameroon
Dominican Republic	Central African Republic
Egypt	Chad
Gabon	Chile
Ghana	China
Guatemala	Colombia
Honduras	Comoros
India	Congo, Dem. Rep.
Indonesia	Cote d'Ivoire
Iran	Djibouti
Jordan	Dominican Republic
Kenya	Ecuador
Madagascar	Egypt, Arab Rep.
Malawi	El Salvador
Mali	Equatorial Guinea
Morocco	Eritrea
Nepal	Ethiopia
Nicaragua	Gambia, The
Niger	Georgia
Nigeria	Ghana
Peru	Guatemala
Rwanda	Guinea
Senegal	Guyana
Togo	Haiti
Turkey	Honduras
Uganda	India

Table C.1 (continued)

1960s to late-1970s	1980s to late 2000s
Zambia	Indonesia
Zimbabwe	Iran, Islamic Rep.
	Jamaica
	Jordan
	Kazakhstan
	Kenya
	Kuwait
	Lao PDR
	Macedonia, FYR
	Madagascar
	Malawi
	Mali
	Mauritania
	Mongolia
	Morocco
	Nepal
	Nigeria
	Oman
	Pakistan
	Peru
	Philippines
	Rwanda
	Senegal
	Sierra Leone
	South Africa
	Syrian Arab Republic
	Tajikistan
	Tanzania
	Thailand
	Togo
	Tunisia
	Turkey
	Ukraine
	Uzbekistan
	Venezuela, RB
	Vietnam
	Zambia
	Zimbabwe

Table C.2: Descriptive statistics for the dependent and independent variables

Period 60s to late 70s					
Variable	Obs.	Mean	Std. Dev.	Min	Max
Aid in mio.	68	124.41	253.46	4.32	1456.87
Aid/GDP	68	0.04	0.04	0.00	0.24
Central Am.	68	0.06	0.24	0	1
Civil War	68	0.04	0.21	0	1
Democracy	68	5.49	4.78	0	19
Egypt	68	0.03	0.17	0	1
Ethn. fract.	68	0.66	0.20	0.15	0.93
French-dummy	68	0.40	0.49	0	1
Height growth	68	0.03	0.44	-0.89	1.54
Initial height	68	168.78	3.38	159.80	174.74
Initial GDP p.c. (log)	60	7.13	0.70	5.82	9.10
Infant mortality (log)	67	4.79	0.28	4.02	5.35
Physicians (log)	68	-2.49	1.24	-4.58	-0.04
Population (log)	68	15.96	1.48	13.12	20.62
Openness	68	0.18	0.38	0	1
SSA	68	0.59	0.50	0	1
Period 80s to late 2000s					
Variable	Obs.	Mean	Std. Dev.	Min	Max
Aid in mio.	141	576.15	648.73	4.97	4423.59
Aid/GDP	141	0.07	0.07	0.00	0.34
Central Am.	141	0.05	0.22	0	1
Change in nutrition	141	2.97	5.41	-11.50	25.2
Civil War	141	0.02	0.14	0	1
Democracy	141	10.81	6.04	.75	20
Egypt	141	0.04	0.19	0	1
Ethn. fract.	141	0.49	0.25	0	0.88
French-dummy	141	0.18	0.39	0	1
Initial GDP p.c. (log)	122	7.63	0.98	5.85	10.75
Infant mortality (log)	141	3.93	0.63	2.09	4.88
Physicians (log)	141	-1.03	1.40	-4.17	1.49
Population (log)	141	16.56	1.54	13.02	20.95
Openness	141	0.81	0.39	0	1
Share not stunted	141	64.63	16.33	28.33	97.53
SSA	141	0.33	0.47	0	1

Notes: Numbers calculated for first two-stage least-squares model of Table 4 and 5 where included variables are non-missing. Aid/GDP minimum values not exactly zero, but very small values below 0.005. Only cases with aid >0 are included in our regressions.

Definitions and sources of variables

Aid is defined as the log share of net official development aid disbursements in current U.S. dollars and GDP in current U.S. dollars. Source: OECD DAC 2a data set (aid (ODA) disbursements to countries and regions). Data available at http://stats.oecd.org.

*Aid*Pol.rights* is an interaction term of aid and the political rights index as calculated by Freedom House. The extent of political rights in a country is coded from 1-7 (7 being the worst), the data is taken from the World Development Report 2011.

Av. Aid6080 is the average flow of Aid/GDP (in logs) to a recipient country from 1960 to 1989.

Centam is a dummy variable that is equal to one if country i is located in Central America and zero otherwise.

Change in stunting (short *dht*) is the dependent variable for the later period. It is calculated as the percentage change of non-stunted children from period t to period t+1: $\text{non-stunted}_{t=1}$- $\text{non-stunted}_{t=0}$.

Intra-state war is coded as a dichotomous variable adopting the value 1 if an intra-state war took place in given country and period. Intra-state wars are wars that are fought within state borders and include wars between non-government forces and a government (civil war) as well as wars between two non-government forces. Sources: Correlates of War Project: http://www.correlatesofwar.org/

Democracy indicates the openness of democratic institutions in a country and is measured on a scale of 0 (low) to 20 (high). The original scale from the Polity IV project ranges from -10 to +10. Source: Polity IV Project, http://www.systemicpeace.org/polity/polity4.htm.

Egypt is a dummy variable equal to 1 if the country is Egypt and zero otherwise.

Ethnic fractionalisation: based on a combination of racial and linguistic characteristics and defined as 1 minus the Herfindahl index of group shares of these characteristics. Source: Alesina et al. (2003). Data available at http://www.nsd.uib.no/macrodataguide/set.html?id=16&sub=1.

GDP p.c. is the average GDP per capita in period t. The data was extracted from the World Bank, http://data.worldbank.org/indicator.

Height describes the average adult male height in the country; measured in centimetres. Sources: Baten and Blum (2012), Measure DHS (Demographic and Health Surveys) project and the World Health Organisation's (WHO) Global Database on Child Growth and Malnutrition.

Height growth or *Ght* if the abbreviation is used (dependent variable for early period) is the growth rate of heights between two decades*:*
$[(height_{t+1} – height_t) / height_t]*100$

Human Development Index or *hdi* is a composite measure of health, education and income. It is an alternative measure of economic progress and was first introduced in the Human Development Report 1990. The data was extracted from the United Nations Development Programme homepage, http://hdrstats.undp.org/en/indicators/103106.html (last access: October 17th, 2013).

Initial GDP p.c. is the per capita GDP (in logs) at the beginning of period t.

Initial height is the average height of the population in country i in t=0.

Initial non-stunted is the fraction of children in country i that were not stunted in t=0. Stunted are children with heights of more than two standard deviations below the mean.

Openness is a variable that ranges between 0 and 1, with 1 being a country with open trade. Source: Sachs and Warner, http://www.cid.harvard.edu/ciddata/ciddata.html.

Physicians is defined as the number of physicians per 1,000 people. Physicians include generalist and specialist medical practitioners. Source: World Bank, http://data.worldbank.org/indicator.

Population (log) is the log of a country's population at the beginning of a ten-year period. Sources: The World Bank and Maddison (2001).

SSA is a dummy variable that is 1 if a country is located in Sub-Saharan Africa and 0 otherwise.

Sum aid6080 is the sum of all flows of Aid/GDP (in logs) to a recipient country from 1960 to 1989.

5. Does food aid improve child nutrition? An anthropometric assessment of children's nutritional status in recipient economies

Abstract

The objective of this study is to empirically assess the impact of food aid on the nutritional status of children in 80 recipient countries between 1995 and 2010. Moreover, we test whether multilateral food aid and U.S. food aid are particularly effective or ineffective compared to aid provided by other donors, as often claimed. The results show that food aid is significantly related to less stunting, while there is no significant relationship between nutritional support and children's weight. There is no clear indication that multilateral donors or the United States perform better or worse than other donors.

Chapter 5 and 6 were written without co-authors. However, the author will still be referred to in the plural due to stylistic reasons and for the sake of consistency.

5.1 Introduction

Malnutrition is still a persistent problem in many countries nowadays, driven by severe poverty, high volatility of food production or sudden natural disasters. One tool to alleviate malnutrition is food aid, which aims at (or is supposed to do so) alleviating general malnutrition, supporting economic and social development and contributing to disaster relief in recipient countries (Colding and Pinstrup-Andersen 2000, p. 195). Modern food aid is not a very recent development tool, but has already been applied in the 1950s. New attention has been drawn to this topic in consequence of the devastating effects of recent disasters such as the Indian Ocean tsunami in 2004 and the food crisis in 2007/2008.

However, the renewed awareness of the importance of food aid to people in need has not spared food aid donors from being in the firing line of the critics. The cause lies partly in the early stages of food aid, when it was a major tool for the disposal of surplus agricultural commodities and aimed primarily at rising profits in the donor country's agricultural sector (Barrett and Maxwell 2005; Clapp 2012, among others). Apart from the doubts about donors' political or economic motivations for providing aid, further concerns have been raised, for example with regard to the right targeting, the speed and flexibility of distribution or the quality of the food distributed, to name only a few. Against the background of these allegations, it is reasonable to ask whether food aid does have positive impacts on the recipients' nutritional status at all or whether it fails to fulfil its purpose. Are the critical statements (still) justified or are they just remnants of past experiences? Indeed, the design of food aid has changed over the years in part because of the change in recipients' needs and in part because donors have learnt from earlier mistakes. For instance, tied[80] in-kind food assistance and programme food aid have become less popular, especially since the 1990s. Instead, donors have shifted towards more flexible and emergency-oriented aid. In this paper, we want to examine whether food aid has yielded a measurable outcome in well-being and nutrition of the recipients.

[80] If aid is tied, donors are only allowed to spend the received aid on products or services from certain countries, mostly the donor country. In the case of food aid, aid is often tied to food produced in the donor country and shipped to the recipient.

Moreover, we consider one particular point of debate, namely the finding that the effectiveness of aid differs substantially, depending on who provides it. In fact, a vast strand of literature has addressed potential donor-specific interests in providing aid.[81] As a result of the research findings, certain donors – in particular the United States – have been suspected of being inefficient in providing help to recipients, as their primary goals might not be linked to recipients' needs but to donors' interest in supporting the local economy or strengthening their political influence. Minoui and Reddy (2010), for example, have empirically shown that official development assistance (ODA) given by certain donors with predominantly developmental goals were more successful in enhancing growth than other donors. With respect to food aid, Neumayer (2005) finds that donors often give preferential treatment to geographically close countries and countries with the same voting patterns in the UN, but his results do not confirm that food aid flows are linked to export interests or military-strategic considerations. Other authors show that non-U.S. project aid is given to populations with high nutritional requirements, while U.S. project aid is allocated towards politically stable and rural regions (Kuhlgatz and Abdulai 2012). As for food availability in the recipient country, U.S. food aid was found to have rather destabilising effects because it was often delivered in times of high U.S. grain surpluses instead of periods with severe nutritional shortages (Barrett 2001). In contrast, multilateral food flows under the World Food Programme were rather provided in times of need, thus flowing counter-cyclically (Barrett and Heisey 2002). However, these studies are mostly conducted for various restricted earlier periods, including food aid flows in the 1960s or 1970s. Therefore, the findings may reflect bad policies during the early stages of food aid and conceal improvements that have been made during the past decades. Not only food policies have gone through a revision process, but donor allocation decisions have changed as well. Donors have been found to be increasingly responsive to need after 1990, which is also true for the U.S. who has targeted countries with low average calorie consumption

[81] The different motives underlying food aid and differences between donors have been studied extensively in the overall aid literature. Alesina and Dollar (2002), for example, find that large donors have rather political and strategic motives for providing aid, while Gates and Hoeffler (2004) provide evidence that Nordic countries have developmental motives and provide aid to particularly poor countries.

(Young and Abbott 2008), while a clear indication of the superiority of multilateral organisations' targeting over bilateral donors' targeting could not be confirmed (Gabbert and Weikard 2000).[82] Disentangling the effects of food aid by major donors might be useful to make sure that positive effects provoked by one donor are not offset by the negative effects of other food aid flows and therefore result in misleading outcomes if we use overall aid in our regression analysis.

Hence, the objective of this paper is twofold: first, to evaluate the impact of food aid on the nutritional status of children in recipient countries and thereby investigating whether food aid's poor reputation is warranted. Second, to analyse whether the effectiveness of food aid varies, depending on the donor by whom it was provided. We investigate food aid's impact on height for age and – in fewer cases – weight for age of children under the age of five for a global sample since 1995. Although the effectiveness of food aid has always been a hotly debated topic, empirical literature on this topic has remained scarce. The difficulty to obtain sound anthropometric data and to disentangle effects of food aid from other variables that have an impact on the nutritional status (Clay et al. 1998) may have contributed to the fact that the topic has been insufficiently studied.

The paper is structured as follows: in the next section, we give an overview of the development of food aid since the early stages and describe the changes that it has gone through ever since. We then discuss the most frequent criticisms and empirical evidence. Section 5.3 elaborates on the empirical design and the data used for this study. Empirical results will be presented in section 5.4, the last section concludes.

[82] Gabbert and Weikard (2000) show that while the US had the lowest performance for project food aid, it performed well for emergency aid. According to the authors the bad results for US project aid stem from the fact that the US is the largest bilateral donor and donates to a wide range of countries, including not only countries with the worst nutritional levels but also those with higher levels of nutrition. This leads to a low performance index.

5.2 Food aid: its history, potential drawbacks and actual achievements

5.2.1 The history of international food aid

International food aid has not only existed for a few decades. In the United States, for example, its history reaches as far back as the early 19th century when the "Act for relief of Citizens of Venezuela" was passed by the Congress. Food aid was also provided during and after the First and the Second World War.[83] Modern food aid, however, began with the Agricultural Trade Development and Assistance Act, more commonly known as Public Law 480 (PL 480), that was approved by the U.S. Congress in 1954. This law provided a legal framework for U.S. food programmes and originated due to several factors. To name only two motives: the U.S were faced with enormous agricultural surpluses and the government, which was the buyer of last resort in farm price support programmes until the 1980s, had to find a way to dispose of the excess production. Furthermore, spreading communism was a concern and providing food aid to developing countries was seen as a possibility to strengthen the bond between recipient countries and the Western world (Shaw 2001, pp. 29). Thenceforward, the PL 480 also served as a model for other bilateral and multilateral aid programmes.

In the early stages of modern food aid, that is, the 1950s and 1960s, food disbursements were primarily given on a bilateral government-to-government basis and were mainly driven by surplus disposal policies and geopolitical motives (Cathie 1986, pp.6; Clapp 2012, p. 1). Moreover, until the 1960s, U.S. food aid represented such a high share of total food disbursements, that one could actually say it *was* overall food aid (Shaw and Clay 1993, p. 5). In the 1970s, international food crises became a major issue. While developing countries were faced with food insecurity, volumes of food aid, however, decreased dramatically as a result of the rise in world commodity prices (Cathie 1986, p. 14). But the devastating nutritional situation, particularly in Asia and Africa, increasingly caught the attention of the international community and enhanced international cooperation on food aid matters. Food and hunger crises, especially in Africa, also remained a central issue in the 1980s. However, it was also a period in

[83] I will not dwell on the indeed very interesting programmes such as the Marshall Plan, as the history of food aid is not the main focus here.

which a rethinking and restructuring progress took place (Shaw and Clay 1993, pp. 5.). Food aid distribution became less donor-driven and more emphasis was put on emergency relief. Moreover, there was a clear shift towards the coordination of food aid issues via multilateral organisations, such as the World Food Programme (WFP) (Clapp 2012, pp. 7, p. 25).[84] The increasing importance of multilateral food aid also relates to the fact that different restrictions and laws in the various donor countries as well as the increasing complexity of the food aid system[85] made bilateral transactions less popular (Barrett and Maxwell, p. 56; Shaw and Clay 1993, p. 8). While the United States is still the biggest bilateral donor today, the World Food Programme (WFP) has become the primary international provider of food aid with clear humanitarian motives. The shift from bilateral to multilateral aid came along with a transition from programme to emergency aid as the preferred type of food aid.[86]

In general, food aid can be subdivided into three different types. *Programme* food aid is given on a bilateral government-to-government basis on soft repayment terms or as a grant for distribution or sale abroad.[87] *Project* food aid can be provided by governments, NGOs or other donors for specific projects, for example food for work or school feeding programmes. Relief or *emergency* food aid is typically given for emergency situations, such as wars or natural disasters (Shaw and Clay 1993). Programme food aid used to be the most frequent form of food aid, until – with the growing importance of multilateral donors – emergency situations shifted to being the dominant factor for receiving food assistance (Barrett and Maxwell 2005).[88] Especially the increasing number of large natural disasters during the last years has increased the

[84] The World Food Programme (WFP) was created in 1961. It became increasingly important as a channel for international food aid after the mid-1970s. For a comprehensive overview of the WFP history, see Shaw (2001).

[85] Since the 1980s, new forms of food aid, such as triangular-relationships evolved, which rendered food aid distribution even more complex.

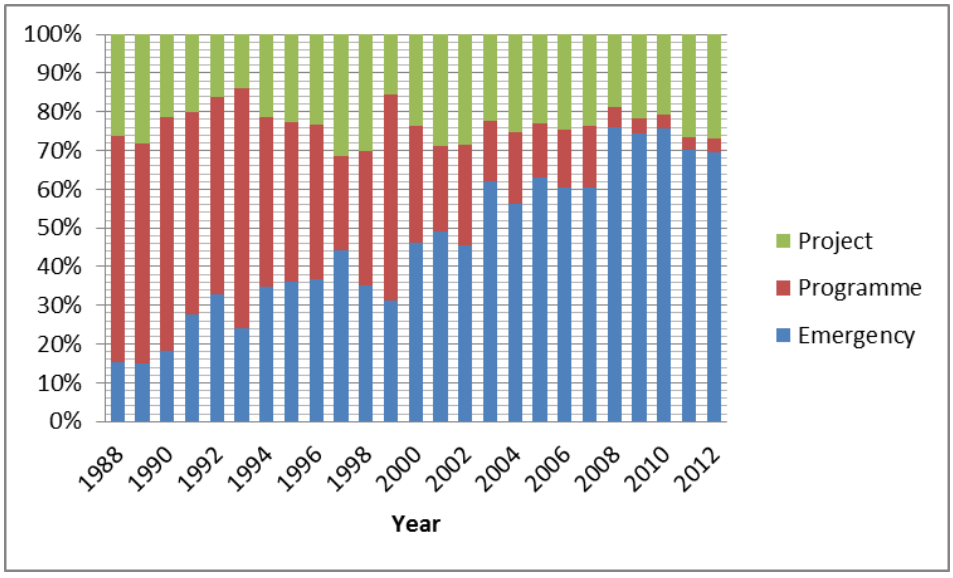
[86] The chance from programme to emergency aid is not to be confused with the change in policy designs that took place for overall development assistance, where programme aid became increasingly important over time.

[87] Programme food aid is often in-kind food aid that is either distributed directly or sold in the recipient countries, such that the revenue can be spent on developmental issues.

[88] Different types of food aid may have different effects on recipients' nutritional status, as was analysed in former research, for example by Arndt and Tarp (2012). In this paper, however, the main question is whether food aid in general has beneficial effects for recipients' well-being and we will therefore not differentiate between the different types in our analysis.

perception that food aid should be delivered in a faster and more flexible way. The tsunami in the Indian Ocean in 2004, for example, required quick large-scale food assistance to the affected population. Food aid shipments from donor countries would have been too slow to provide immediate help and, furthermore, would have been dependent on the availability of commodities in the donor country. The increasing awareness of the need for a quick and flexible provision of food encouraged more cash-based responses in emergencies as well as local and regional procurement of food (Lentz et al. 2013). Figure 5.1 shows that the switch from programme food aid as the predominant form of delivery towards emergency food aid took place around the turn of the millennium.

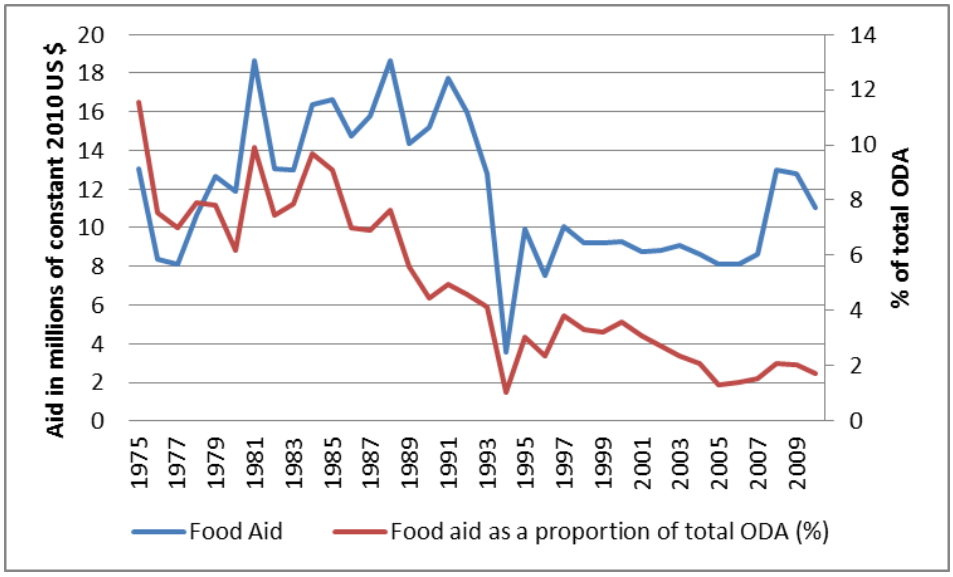
Figure 5.1: Shares of project, programme, and project food aid, 1988-2012



Source: WFP FAIS database. http://www.wfp.org/fais/.

Although the popularity of international food aid donations and the enthusiasm for more flexible solutions increased, the share of food aid with regard to total official development assistance (ODA) decreased over time. While food aid still accounted for a 16% share of total aid flows in the mid-1970s, the share diminished to around 12% during the 1980s and decreased even further in the subsequent periods, as Figure 5.2 shows.

Figure 5.2: The development of food aid as share of total ODA over time



Notes: data from DAC 2a data set of the OECD. ODA: Official development assistance.

It is interesting to note that – apart from the fact that food aid to developing countries has always been extremely volatile – there was a sharp decrease in food disbursements since the 1990s. Part of the explanation for this lies in the fact that food aid flows are driven by supply-side influences (Harvey et al. 2010). The sharp drop in food aid in the mid-1970s, for example, can be viewed as a result of the world food crisis of the 1970s and the corresponding tightening of food markets. As food aid programmes were often budgeted in financial terms and not in tons, fluctuations can also be explained with the fluctuation of prices of food. The 1990s were a period of several policy changes with respect to food aid. A large number of donors, including the European Union and Canada, turned their backs on programme aid which also resulted in a sharp decline of the overall food aid flows. Moreover, the U.S. as the major donor of food aid has continuously reduced its overall development assistance, including food aid (Clay and Stokke 2010).

The destination of food assistance was also subject to changes over the decades. Asia, who was the main recipient of food aid during the 1970s, was gradually replaced by Sub-Saharan Africa as the main beneficiary of food support during the 1980s and early 1990s. At this point in time, Asia was able to increase its cereal production and finance imports commercially, while Sub-Saharan Africa was faced with a gap in food

production and demand. Large food aid donations were also temporarily provided to the former Soviet countries at the beginning of the 1990s (Maxwell and Barrett 2005; Clay and Stokke 2010).

5.2.2 Points of criticism with regard to food aid's effectiveness

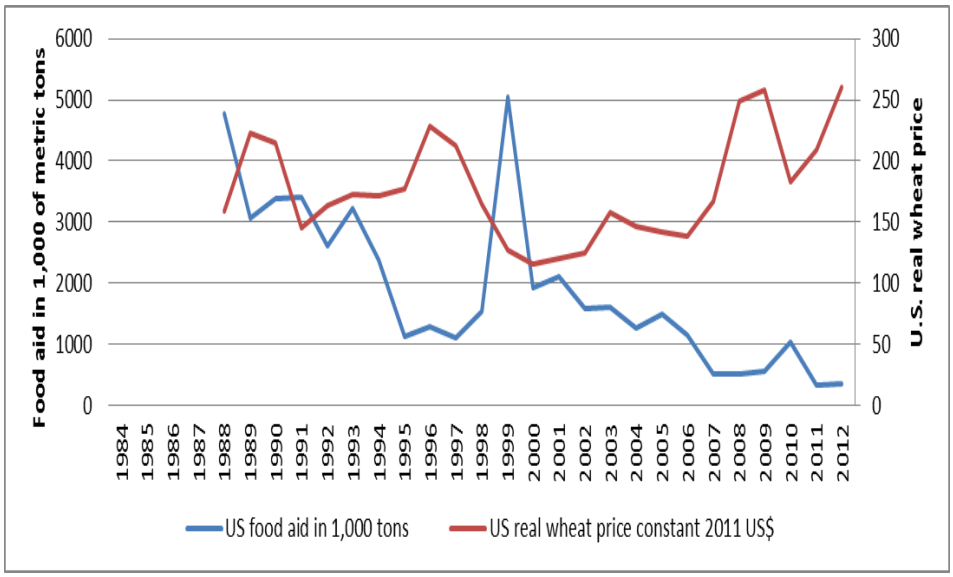
One of the main criticisms which has been expressed in the food aid debate has its origins in the 1950s and 1960s, when food aid was often used as a means of disposing of developed nations' surplus agricultural products, especially grain, in order to increase local farmers' incomes (Clapp 2012, p. 1; Levinsohn and McMillan 2007, p. 562; Barrett and Maxwell 2005, p. 19). This donor-driven approach to aid has been widely criticised for several reasons. First of all, it is obvious that bilateral food aid flows undertaken by donors to support local agriculture are procyclical with supply and countercyclical with prices. Therefore, food aid flows are particularly high when grain stocks are high and prices low and thus during periods when developing countries might not face severe malnutrition problems (Clapp 2012, p.35).[89] Conversely, it has been observed that food aid flows were particularly low during food aid crises, for example in 1974 and during the 1990s (Barrett and Maxwell 2005, pp. 27). Looking at the relationship between food aid flows and real wheat prices of the largest food aid donor — the United States of America[90] — we find evidence that the criticism is justified. Figure 5.3 shows that wheat food aid shipments decreased when wheat prices peaked. During the food crisis in 2007, when food aid would probably have been needed most urgently, food shipments were particularly low.

Barrett and Maxwell (2005, p.32) argue that there is an automatic linkage between food aid shipments from a fixed dollar budget and producer prices, as less food can be purchased from this budget at high price levels. Especially if food aid is tied, that

[89] Of course, a bad harvest in the donor country does not imply that recipient countries suffer from bad harvests or natural disasters at the same time. However, the global food prices are strongly influenced by harvests in countries that are major producers of foodstuffs (which are very often also large food aid donors) and thereby affect food availability in developing countries, as well.

[90] We use the United States as an example, because real producer prices can be calculated more accurately for a single nation and the United States were most frequently associated with this particular criticism. However, data for shipments from NGOs and the European Union (data: INTERFAIS) show the same pattern (see Figure A1 and A2 in the appendix).

Figure 5.3: U.S. wheat food aid shipments and producer prices



Notes: Data on wheat food shipments are from the World Food Programme (WFP) International Food Aid Information System (INTERFAIS). Nominal prices of U.S. wheat are from the U.S. department of agriculture: http://www.usda.gov/wps/portal/usda/usdahome?navid=DATA_STATISTICS. Real prices were calculated by using the GDP deflator of the World Bank.

is, goods and services (such as shipment) must be bought from suppliers of the donor country, the amount of food aid is heavily dependent on prices in the donor country. In case of a severe bottleneck in the production, the donor might not even be able to keep recent budget levels.[91]

Time and cost-inefficiency is another topic that has been widely debated. If food aid is given as in-kind assistance – which usually means that foodstuffs (mostly grain) are shipped from the donor to the recipient country – relatively high transport costs and transport times are involved. Particularly in the event of natural disasters, when immediate nutritional support is crucial, the time delay might have devastating implications. Moreover, the financial resources that are spent on transport could have been allocated more efficiently elsewhere. Some donors have tried to respond to these problems by purchasing food locally or in other developing countries that are net food

[91] In figure 3, the food aid budget sometimes decreases before wheat prices increase. This probably stems from the fact that — in contrast to the data used in the regressions below — commitments instead of actual disbursements are reported here. Food aid commitments can be adjusted downwards before an actual price increase, for example if a bad harvest is expected.

exporters. However, tied aid[92] still accounts for approximately 80 per cent of total food aid (Awokouse 2011, p. 496). In the case of Ethiopia, only 59,000 tonnes of wheat intended for nutritional support have been purchased locally in contrast to 1,074,000 tonnes of imported wheat in the year 2000 (Levinsohn and McMillan 2007, p. 566).

Poor targeting is another big issue in the food aid debate (OECD 2013; Awokouse 2011, p. 494, among others). Do donors really give the largest share of food aid to countries with the greatest need or do they link food aid to political interests? And does food aid — once distributed to a recipient country — flow to the poorest households or do people with higher incomes benefit from it? Some studies provide evidence that overall food aid has generally been allocated to the neediest countries, but quantities were not big enough to stabilise consumption (Gupta et al. 2004; Kuhlgatz et al. 2010). Neumayer (2005) has examined donors interests in the allocation of food aid in more detail and finds a preferential treatment of geographically close countries and those countries with the same voting patterns in the UN, while neither military-strategic or export interests nor preferential treatment of former colonies play a major role. On the within-country income level, food-for-work programmes were found to rather benefit households in the middle and upper tail of the consumption distribution, while poor households actually benefit from free distribution (Gilligan and Hoddinott 2007). Finally, food aid has been criticised for being poor in quality and not containing enough micronutrients to improve the nutritional status of the recipients (Clay et al. 1998).

In consequence of the above-mentioned inflexibility and inefficiency of conventional government-to-government in-kind food aid, many donors have recently switched to cash and voucher distribution or local and regional procurement. However, this kind of nutritional support – that is supposed to be free from donor interest bias and delays in delivery – has been suspected to have certain disadvantages as well. In particular, there is concern about potential effects of local procurement on food prices and increasing market price volatility in procurement countries. Although previous studies were unable to confirm such effects for the recent past (Garg et al. 2013), local

[92] Meaning it is given on the condition that it will be used to buy goods or services from a specific country or region (mostly the donor country). Tied food aid is therefore either in-kind aid shipped from the donor country (or another country that is chosen by the donor) or monetary aid that has to be spent on food or services produced by the donor country.

procurement might become a critical issue once food will be bought by an increasing number of different food assistance actors in the future, as coordination might become more difficult with increasing volumes of purchased food (Lentz et al. 2013). This and the arguments discussed above cast severe doubts on food aid's effectiveness in improving recipients' nutritional status and well-being.

5.2.3 Evidence of food aid's effectiveness so far

Empirical evidence on whether food aid actually succeeded or failed to improve the nutritional and health status of recipients is limited and mostly examines the situation in individual countries. Moreover, several approaches and methodologies have been used to measure the effectiveness of nutritional support and the study results are therefore hardly comparable. The most frequently used performance indicators include, among others, child growth, caloric intake and mortality rates.

Clay et al. (1996), for example, analyse whether the European Union Programme aid was able to improve food security – in terms of overall food availability and access to a nutritious diet by all people – for a set of developing countries. They show that, on balance, the EU programme aid had marginally positive impacts on food security but note that the effects were relatively small, particularly in view of the high transaction costs involved. This is in line with a survey evaluating more than 200 past food aid programmes: feeding programmes targeted at young children in developing countries have been found to be quite expensive compared to their effect on anthropometric outcomes (Beaton and Ghassemi 1982). McClelland (1998) evaluates the effect of U.S. food aid on the nutritional status of children below the age of five for a selection of countries[93] but does not find any unambiguous effects of the nutritional support on child malnutrition. One possible explanation for the unsatisfactory performance is, according to the author, that children's food rations were relatively small despite of the food supplement, because the latter was shared among family members. A more positive view on food aid is provided by Plümper and Neumayer (2007) who find that international food aid has a life-saving effect during

[93] Bangladesh, Ethiopia, Ghana, Honduras, Indonesia and the Sahel region.

famines[94], especially when the share of affected people in the population is particularly high. In addition, the authors show that food aid works better in democracies than in autocratic regimes.

Ethiopia, in particular, has been subject to abundant research, probably because it is exceedingly affected by food crises. Yamano et al. (2005) find a large positive impact of food aid on early child growth in Ethiopia: children between six and 24 months in food aid receiving communities grew on average 1.8 cm faster than children who did not receive food aid. Moreover, food aid is shown to serve particularly well to alleviate temporary income shocks, such as droughts. However, the authors criticise that targeting is not efficient enough as food aid seldomly flows to communities that are exposed to severe shocks. The positive effects of food aid on child growth (Porter 2010; Gilligan and Hoddinott, 2007) and household income (Levinsohn and McMillan 2007) in Ethiopia are confirmed by several other studies. Equally positive results were found for food-for-work programmes in Kenya (Bezuneh and Deaton 1997; Bezuneh et al. 1988).

A more differentiated picture is drawn by Broussard (2012) who evaluates food aid's effect on adult body mass indices and finds that adult male household members profit more from aid transfers, while women from poor households are adversely affected by aid receipts. The discrimination of females is less clear for Ethiopian children: which gender profits from food aid depends on the gender of the adult recipient as well as on the form of food aid (i.e. whether it was freely distributed or distributed via food-for-work programmes; Quisumbing 2003).

5.3 Data and empirical design

5.3.1 Data and descriptive statistics

Our intent is to estimate the effect of food aid on child nutrition. As the dependent variable, we use the stunting indicator (height for age) of the World Bank that estimates the percentage of children under the age of five whose height for age is

[94] The authors use the number of people killed by famines and droughts in a country during a given year as dependent variable.

more than two standard deviations below the median for the international reference population of the same age. To put it in a nutshell, it is the percentage of stunted children in a country. The data are based on the World Health Organisation's (WHO) new child growth standards released in 2006. In order to make the regression outcomes easier to interpret, we do not use the percentage of stunted children, but rearrange the variable, such that the dependent variable states the percentage of children that are *not* stunted and therefore presumably in good health (thus, a positive coefficient in the regression output indicates a positive effect of food aid on health). Just like the data on total official development assistance (ODA) in chapter 4, food aid data is provided by the Development Assistance Committee (DAC) of the OECD. Again, we use disbursement data instead of data on commitments, meaning that the stated amount is actually disbursed to the recipient country in the given year. We only include countries in the regression that have received food aid at least once within the period under study (1995 onwards).

Several external factors that might have an effect on the nutritional and health status of children and therefore on their height and weight are also controlled for. For instance, we include infant mortality, government health expenditure, the percentage of women receiving prenatal care, immunisation rates as well as the HIV rates to account for the health environment in a country.[95] The share of arable land and the share of the population living in rural areas could provide information on the availability of food. Countries with a high share of arable land, for instance, are more likely to be able to provide a sufficient amount of domestic food supply. Moreover, highly rural societies might have different access to food despite poverty as they are more likely to grow their own food. Countries with poor records in political rights might distribute resources differently than fully democratic countries. More specifically, democracies are more likely to channel food aid to people in need, whereas autocracies might prefer to distribute resources to the elite or important political supporters (Plümper and Neumayer 2007). Therefore, we also include the political rights score by Freedom

[95] The number of doctors per 1,000 people was too closely correlated with the infant mortality rate and was therefore omitted.

House.[96] Sources and definitions of other explanatory variables can be found in the appendix.

Table 5.1 shows the descriptive statistics of the variables used in the regression analysis. On average, the amount of food aid accounts for less than 1% of GDP, which is in line with the findings of chapter 5.2: food aid flows have become relatively small since the 1990s.[97] 33.8% of the children below the age of five are stunted (66.2% not stunted) in the average country in our regressions.

Table 5.1: Descriptive statistics

Variable	Observ.	Mean	Std. Dev.	Min	Max
Food aid/GDP	170	0.00	0.01	0.00	0.03
Food aid in mio.	170	19.42	29.94	-0.37	177.17
(No) Stunting	170	0.66	0.15	0.37	0.99
(No) Malnutrition	147	0.80	0.12	0.48	0.99
Agricult. Land	170	0.47	0.19	0.00	0.88
GDP p.c.	170	3095.60	3116.29	390.04	15992.82
Health exp.	170	0.10	0.04	0.00	0.24
HIV	170	0.03	0.05	0.00	0.27
Infant mortality per 1,000 births	170	61.26	31.71	5.10	141.90
Civil war	170	0.06	0.24	0.00	1.00
Political rights	170	4.05	1.77	1.00	7.00
Prenatal care	170	0.77	0.19	0.23	1.00
Rural population (%of total)	170	0.59	0.19	0.09	0.92
Immunisation (dpt)	170	0.76	0.19	0.22	0.99
Immunisation (measles)	170	0.76	0.19	0.16	0.99

Notes: Numbers are calculated for the fixed effects regressions of Table 5.3 where included variables are non-missing. Food aid/GDP minimum values are not exactly zero, but very small values below 0.005. Immunisation (dpt) is the rate of children that were adequately immunised against diphtheria, pertussis and tuberculosis. Where variables are defined as percentages, values are divided by 100: a value of 0.5 is therefore equal to 50%.

A closer look at the data reveals which countries suffer from particularly severe stunting and malnutrition and whether these countries are also the main recipients of food aid. Table 5.2 shows the ten countries with the highest average percentage of stunted or

[96] We do not use the Polity IV data in this paper, because the Freedom House data provides a more abundant data set for the period under study.

[97] The high maximum value for "other aid" is due to the high amounts of official development assistance given to Liberia after the Second Liberian civil war (1999-2003).

malnourished children in the period under study (1995 onwards), as well as the countries that received the highest average amount of total food aid and food aid relative to GDP. Ethiopia, Bangladesh, Malawi, India and Eritrea are amongst the top ten recipients of food aid and also amongst the countries with the highest percentage of stunted and malnourished children. Therefore, the critique that donors do not provide aid to the neediest countries does not seem justified at a first glance, at least for the post-1995 period

Table 5.2: Countries with highest average values of malnutrition, stunting and food aid

Rank	% stunted		% underweight		Food aid/GDP		foodaid in Mio U.S.$	
1	Burundi	63.1	Bangladesh	47.2	Liberia	0.03	Ethiopia	124.6
2	Nepal	57.7	Yemen, Rep.	45.4	Eritrea	0.02	Bangladesh	87.3
3	Afghanistan	56.3	India	44	Cape Verde	0.02	India	65.8
4	Angola	56.3	Niger	42.8	Tajikistan	0.01	Mozambique	49.9
5	Yemen, Rep.	55.8	Nepal	40.7	Rwanda	0.01	Haiti	44.1
6	Bangladesh	55.6	Timor-Leste	40.6	Malawi	0.01	Afghanistan	42.5
7	Malawi	55.5	Burundi	38.9	Haiti	0.01	Peru	38.4
8	Timor-Leste	55.3	Ethiopia	38.3	Sierra Leone	0.01	Bolivia	31.5
9	Ethiopia	54.1	Eritrea	36.4	Mozambique	0.01	Malawi	30.2
10	Guatemala	53.2	Madagascar	36.2	Ethiopia	0.01	Indonesia	30.1

Notes: The values are the average numbers for the entire period under study. Sources: Food aid: OECD; % stunted and % underweight: World Bank.

5.3.2 Empirical design

Children's height and thereby also stunting (defined here as having a height for age that is at least two standard deviations below that of the reference population) is determined by several factors. We draw on Alderman et al.'s (2006) approach that defines height of a pre-school child as a function of child specific effects, household characteristics and community characteristics. More specifically, child specific effects are time invariant characteristics specific to a certain child, such as sex or genetic characteristics. Household characteristics such as parents' tastes or wealth and their investment in the offspring's health are common for all individuals living in this household, and community effects are the restrictions or options posed upon the child due to living in the community. As we do not evaluate food aid's impact on

malnutrition on an individual- but on the country level, we are rather interested in the effects that are specific to a country and do not account for individual and household specific effects. We therefore abstract from Aldeman et al.'s model and write

$$\text{No Stunting}_{it} = \alpha + ß\, X_{it} + \gamma_i + u_{it}$$

where α is a constant and γ_i are time-invariant country characteristics, such as the genetic potential or food tastes due to cultural preferences. In this case, γ_i are simply country fixed effects, as country-specific characteristics that affect malnutrition are hard to measure. X_{it} is a vector of country-specific characteristics that may vary over time (such as GDP, provision of health services, nutritional availability during a particular time, civil war), and u_{it} is the error term. Included in the vector of variables is our factor of interest: food aid.

We include food aid flows in period t=0, but also control for past food aid flows. The reason for this is that food aid might not have an immediate impact on a child's height, but the body might take a certain time to react to the change of available food quantities. We therefore include a control variable for the average amount of food aid that was given between t-1 and t-5 and, thus, control for food aid flows since the time of birth. We also include deeper lags in some cases that account for food aid's impact on the mother's nutritional status. We do so because adverse shocks during the fetal period, which involves the health status and nutrition of the mother, as well as her smoking or drinking habits, may lead to low birth weight, long-term health effects, disability or poor cognitive development of her child (Almond and Currie 2011). Moreover, lags should account for the fact that the contemporary amount of food aid might very well be correlated with past amounts of food aid.[98] In most of the specifications, we only use lagged food aid instead of food aid flows at time t=0, as there might be the problem of reverse causality: countries with high levels of malnutrition are more likely to receive high amounts of food aid, at least if food aid is given for developmental purposes.

[98] We tested for autocorrelation of error terms and multicollinearity. Both were rejected in the tests. Therefore, including several lags of food aid does not pose a statistical problem here.

The most elegant way to solve this problem would be to use an instrumental variables (IV) approach. We tried this with several potential instruments[99], which, however, did not pass the critical value of 10 in the F-test and were therefore discarded. Another solution could be to apply an autoregressive distributed lag model or GMM estimation methods. The difficulty in doing so in this case lays in the fact that we have a strongly unbalanced panel. Although we have a very good data base for food aid, the data on malnutrition is not available for each and every year. Hence, using lags of the dependent variable leads to a strong reduction in the number of observations. We are thus bound to use the easiest way of dealing with reverse causality and mostly use lagged values of food aid. Therefore, the results have to be treated with caution and we should rather speak of correlation or association instead of causality when interpreting the coefficients.

Using lagged food aid instead of contemporary food aid flows has one further advantage. When we look at food aid disbursements we have to keep in mind that disbursements given in a particular year may need some time to, firstly, arrive at the final recipient and, secondly, have an effect on the recipient's health. As we do not differentiate between in-kind food aid or cash-based aid here, we have to keep in mind that there generally is a substantial time lag between the initial shipment and delivery date in the case of in-kind food aid (Barrett and Maxwell 2005) or between the time of payment of monetised aid and the delivery of the purchased food. In short, there is a time-lag between initiating the intervention and the implementation. The second time-lag we have to consider is the time between the distribution of food to the recipient and the measurable response in growth (or, if we use weight for age, the gain in weight, which would have a shorter time-lag than height for age). An additional challenge in our estimation, as described above, arises from the fact that the panel is unbalanced. We

[99] For example, we tried to instrument food aid with the number of natural catastrophes in the biggest wheat producing countries because wheat is the main commodity given as food aid. As food aid flows are often counter-cyclical with wheat prices, catastrophes in the main producer countries may lead to higher prices and less disbursements. Moreover we used changes in policies in the main donor country (U.S.A.) as different political parties might have different developmental strategies and changes in precipitation.

apply weights that account for the probability of being included in the sample, such that every country has the same importance in the results.[100]

Although children's height reacts relatively promptly to an improvement in nutrition and health conditions, it does not react as directly to changes in these factors as weight. The indicator "prevalence of undernutrition, weight for age", that is used as dependent variable in some of the specifications, should be able to reflect the short-term influences of food aid on nutrition.

In a next step we pick up an idea by Minoiu and Reddy (2010) who argue that – in the case of overall aid flows – the aggregate nature of the total aid variable might lead to erroneous conclusions if donors' intentions for providing aid differ.[101] More specifically, the authors state that if some donors give aid for developmental purposes (in the case of overall aid, Northern European Countries have been found to be most likely to give aid without having strategic interests, Gates and Hoeffler 2004; Alesina and Dollar 2000, among others) and others out of non-developmental reasons, aid given by different donors could also have different effects on the dependent variable in which case the standard model used in the aid-literature would be misspecified. While Minoiu and Reddy (2010) define single nations as being pro-developmental (or not), this classification would not be appropriate when analysing food aid. Since the late 1980s, a considerable share of food aid is channelled through multilateral organisations, such as the World Food Programme and the European Union, which account for more than half of the total food aid distributions nowadays (Broussard 2012). U.S. food aid, on the other hand, is provided mostly on a bilateral basis and still represents a large share of overall food aid. These two donors – multilateral organisations and the United States- are the most important donor groups that might also show different distribution patterns. As multilateral food aid is generally believed to be rather developmental and U.S. food aid suffers from a historically founded bad reputation, it might be interesting to disentangle the different effects of these kinds of food aid. Kuhlgatz (2010), for

[100] Fixed effects regressions without probability weights are provided in the appendix to see whether the results are significantly different.

[101] Minoiu and Reddy (2010) analyse the impact of overall aid on GDP growth. However the effectiveness of food aid on nutrition suffers the same challenges, therefore it might be reasonable to differentiate between different donors.

example, shows that U.S. project aid rather focuses on politically stable and rural regions while non-U.S. project aid is targeted towards populations with high nutritional requirements. As different donor motivations can also result in varying outcomes, we investigate whether there is empirical evidence that the U.S. and multilateral organisations perform particularly well or poorly.

5.4 Empirical Results

The regression results in Table 5.3 show that food aid distributed between t-1 and t-5 is positively and significantly related to children's height: a one standard deviation increase in lagged food aid is associated with a 0.12 (model 3) to 0.18 (model 1) standard deviation increase in the percentage of children that do not suffer from stunting.[102] Food aid therefore seems to be better than its reputation. Despite all the criticism, food aid distributions since the mid-1990s have made a significant contribution to alleviating hunger and thereby reducing the probability of being stunted for children in recipient countries.

The weight of children in recipient countries is not significantly correlated to food aid that was provided between the time of birth and one year prior to the time of observation (Table 5.4).[103] The coefficient for contemporary food disbursements is negative and significant (model 1 of Table 5.4). However, it might be misleading to assume that food aid has a negative impact on children's weight. The negative and significant outcome might be put down to reverse causality effects as food aid is more likely to be given to countries with a high percentage of underweight children.

[102] The deeper lags of food aid serve as control variables but are not of interest for our interpretation, as we only want to explain the impact on children's well-being. Children's height cannot be directly influenced by food aid that is given prior to their birth. However, earlier food aid flows might have a significant impact on prior generations and thereby on the offspring's height and are thus controlled for. Trying to interpret these variables would be highly speculative. As mentioned above, autocorrelation of error terms and multicollinearity was rejected by statistical tests. Therefore, including several lags of food aid does not pose a statistical problem here. However, we also tested specifications where we only included one of the lagged food aid variables (not shown here), which did not change the results.

[103] Deeper lags were not included in the regression, as weight is a measure that acts rather promptly in contrast to height that might need longer periods to catch up and might be predetermined by previous generations' well-being. To make the regressions comparable, we also included deeper lags in regressions not shown in this table, which did not lead to changes in our variable of interest (Tables available from the author).

Table 5.3: Food aid's impact on (no) stunting, fixed effects estimates

	(1)	(2)	(3)
Food aid	0.120		
	(0.953)		
Food aid Lag 1-5	3.796**	3.737***	2.500*
	(0.035)	(0.006)	(0.063)
Food aid Lag 6-10	-1.102	-1.127	-2.299**
	(0.331)	(0.312)	(0.035)
Food aid Lag 11-15	2.130**	2.100**	
	(0.027)	(0.022)	
Health expenditure of gov.	-0.133	-0.134	-0.196
	(0.402)	(0.400)	(0.212)
Political rights	0.002	0.002	0.003
	(0.744)	(0.743)	(0.705)
Intra state war	0.008	0.008	0.007
	(0.623)	(0.616)	(0.694)
HIV	-0.692	-0.689	-0.676
	(0.355)	(0.356)	(0.378)
Infant mortality	0.475	0.468	-0.599
	(0.709)	(0.717)	(0.604)
GDP p.c. (log)	-0.014	-0.015	-0.015
	(0.690)	(0.688)	(0.656)
Agricultural Land	-0.051	-0.049	-0.148
	(0.825)	(0.828)	(0.524)
Immunisation (measles)	0.059	0.059	0.063
	(0.379)	(0.386)	(0.366)
Prenatal care	0.126**	0.126**	0.101*
	(0.029)	(0.028)	(0.088)
Rural population	-0.041	-0.042	-0.282
	(0.901)	(0.900)	(0.388)
Constant	0.657**	0.659*	0.953***
	(0.046)	(0.051)	(0.003)
Time FE?	Yes	Yes	Yes
Country FE?	Yes	Yes	Yes
N	172	172	172
Within-R2	0.405	0.405	0.362

Notes: P-values in parentheses, ***, **, * significant on the 1, 5, and 10%-level. Country and time fixed effects and probability weights applied in every specification. Standard errors are heteroskedasticity and cluster-robust.

Table 5.4: Food aid's impact on (no) underweight, fixed effects estimates

	(1)	(2)
Food aid	-3.055**	
	(0.013)	
Food aid Lag 1-5	-0.758	0.559
	(0.330)	(0.257)
Health expenditure of gov.	-0.0111	-0.021
	(0.912)	(0.837)
Political rights	0.002	0.003
	(0.516)	(0.421)
Intra state war	-0.004	-0.004
	(0.714)	(0.759)
HIV	-0.137	-0.187
	(0.578)	(0.497)
Infant mortality	-1.283	-1.566*
	(0.122)	(0.051)
GDP p.c. (log)	0.009	0.016
	(0.705)	(0.481)
Agricultural Land	-0.088	-0.125
	(0.513)	(0.441)
Immunisation (measles)	-0.068	-0.048
	(0.147)	(0.303)
Prenatal care	0.131***	0.119***
	(0.003)	(0.005)
Rural population	0.101	0.010
	(0.645)	(0.956)
Constant	0.706***	0.717***
	(0.004)	(0.004)
Time FE?	Yes	Yes
Country FE?	Yes	Yes
N	153	153
Within-R2	0.644	0.605

Notes: P-values in parentheses, ***, **, * significant on the 1, 5, and 10%-level respectively, probability weights as well as country and time fixed effects applied in every specification. Standard errors are heteroskedasticity and cluster-robust.

Admittedly, the same argument goes for populations with a high share of stunted children and yet we do not find significant negative effects of contemporary food aid on stunting (Table 5.3, model 1). A tentative explanation for this could be that – as weight reacts more quickly to external influences than height – a high proportion of underweight children indicates that a country is currently facing a severe food crisis and donors react promptly by providing emergency aid. A high share of stunted children, on the other hand, tends to point to persistent food insecurity. One could therefore assume that donors react differently to short-term food crises, often triggered by external shocks, and persistent nutritional shortages in a recipient country. The question whether the negative and significant coefficient of contemporary food aid indicates that there is reverse causality or whether food aid has indeed a negative impact on nutritional outcomes in the short run cannot be answered in this study due to the above-mentioned statistical restrictions.

If all food aid donors have the same (developmental) goals in providing food aid, then the effects of food aid on well-being are uniform. If, however, different donors are giving aid for different reasons, then the effect of food aid on stunting and malnutrition might also vary, depending on who provided it. Table 5.5 shows the results for the regression analysis that evaluates the efficiency of U.S. food aid in comparison with other donors. U.S. food aid provides neither better nor worse results than other donors' food provisions when it comes to children's heights (models 1 to 3 of Table 5.5). Only contemporary U.S. food aid performs significantly worse. Again, this coefficient should be handled with caution, as it might simply reflect that the U.S. is giving more food aid to countries that currently have a high percentage of stunted children (and therefore react to generally bad nutritional conditions and not only to natural disasters). There is no significantly different effect of U.S. food aid on the percentage of underweight children (model 4 of Table 5.5). Likewise, no better or worse performance compared to other donors can be found for multilateral donors: Table 5.6 shows that multilateral aid has neither a significantly different impact on stunting (models 1 to 3) nor on underweight (model 4).

A factor that also seems to be crucial for the well-being of children is prenatal care. Throughout every regression and specification in Tables 5.3 to 5.6, prenatal care has a

positive and significant impact on the outcome variable. As already mentioned above, maternal health and nutrition can affect the offspring's health to a great extent. The results confirm that prenatal care – by improving maternal health during pregnancy – has a positive effect on the child's physical development. Apparently, the availability of good medical care during pregnancy is a crucial determinant for the offspring's health.

To sum up, there seems to be some positive impact of food aid on children's height for the post-1995 period (or at least a positive relation). However, a positive correlation between food aid and the weight of children, which reacts more quickly to external influences than height, could not be found. Moreover, the frequently discussed statement that U.S. aid is less effective than food aid provided by other donors, particularly multilateral organisations, could not be confirmed here.

5.5 Conclusion and Policy recommendations

This paper addressed food aid's role in affecting recipients' health. As food aid has often been criticised for not being efficient in improving peoples' lives, we first explained how food aid has developed over time and discussed the main criticisms regarding this development tool. In a second step, we empirically analysed whether the criticism that food aid is ineffective in improving the recipients' health is justified and also tested whether U.S. food aid still deserves its historically grounded poor reputation. The paper shows that food aid has changed considerably during the last decades. The amount of food aid has decreased over time, but donors also seem to have tried to learn from previous mistakes. While programme food aid on a government-to-government basis was the predominant form of food assistance until the 1980s, donors have shifted towards more flexible and need-oriented ways of providing nutritional support. The results show that for the post-1995 period, (lagged) food aid is positively and significantly correlated with the percentage of children that are not stunted. In some cases, food aid that was provided before the time of birth was also positively and significantly correlated with the outcome variable. This might be explained by the fact that a good nutrition of the mother also results in favourable health conditions of her child and therefore food aid can be considered to have a long-lasting effect.

Table 5.5: U.S. food aid's impact in comparison to other donors

	(1)	(2)	(3)	(4)
Dep.var.		no stunting		no malnutrition
Food aid U.S.	-4.051**			-3.115
	(0.036)			(0.183)
avus1to5	4.086	2.662	0.291	-0.124
	(0.159)	(0.246)	(0.833)	(0.924)
FA U.S. Lag 6-10	-3.379	-2.681		
	(0.214)	(0.174)		
FA U.S. 11-15	2.225			
	(0.318)			
Health expenditure gov.	-0.346	-0.289	-0.213	0.058
	(0.144)	(0.178)	(0.293)	(0.640)
Political rights	-0.000	0.003	0.004	0.002
	(0.960)	(0.644)	(0.548)	(0.496)
Intra state war	0.009	-0.006	0.000	-0.006
	(0.610)	(0.736)	(0.995)	(0.628)
HIV	-0.339	-0.409	-0.542	-0.173
	(0.632)	(0.531)	(0.401)	(0.473)
Infant mortality	0.076	-0.077	0.096	-1.823**
	(0.949)	(0.950)	(0.939)	(0.020)
GDP p.c. (log)	-0.031	-0.018	-0.030	0.012
	(0.541)	(0.701)	(0.510)	(0.588)
Agricultural Land	0.129	-0.116	-0.147	-0.132
	(0.552)	(0.626)	(0.524)	(0.355)
Immunisation (measles)	0.001	-0.011	-0.022	-0.059
	(0.988)	(0.894)	(0.779)	(0.189)
Prenatal care	0.138**	0.105*	0.114*	0.125***
	(0.023)	(0.065)	(0.054)	(0.004)
Rural population	-0.423	-0.250	-0.191	0.047
	(0.310)	(0.450)	(0.566)	(0.825)
Constant	0.969**	0.932**	1.027**	0.749***
	(0.044)	(0.038)	(0.018)	(0.003)
Time FE?	Yes	Yes	Yes	Yes
Country FE?	Yes	Yes	Yes	Yes
N	157	166	168	153
Within-R2	0.433	0.351	0.347	0.633

Notes: P-values in parentheses, ***, **, * significant on the 1, 5, and 10%-level respectively, probability weights included in every specification. Heteroskedasticity-robust and clustered standard errors applied in every model.

Table 5.6: Multilateral food aid's impact in comparison to other donors

	(1)	(2)	(3)	(4)
Dep.var.	(No) stunting			(No) underweight
Food aid mult.	6.674			-1.065
	(0.321)			(0.822)
FA mult Lag 1-5	5.617	6.253	6.437	4.871
	(0.471)	(0.332)	(0.315)	(0.131)
FA mult. Lag 6-10	2.265	-1.591		
	(0.656)	(0.603)		
FA mult. Lag 11-15	6.272			
	(0.165)			
Health expenditure gov.	-0.200	-0.177	-0.152	-0.0160
	(0.573)	(0.472)	(0.463)	(0.882)
Political rights	0.003	0.004	0.004	0.003
	(0.628)	(0.599)	(0.610)	(0.385)
Intra state war	0.00620	0.001	0.001	-0.003
	(0.737)	(0.963)	(0.976)	(0.801)
HIV	-0.802	-0.571	-0.495	-0.184
	(0.294)	(0.426)	(0.450)	(0.515)
Infant mortality	-0.054	-0.600	-0.456	-1.700**
	(0.975)	(0.631)	(0.720)	(0.047)
GDP p.c. (log)	-0.054	-0.028	-0.027	0.021
	(0.331)	(0.517)	(0.520)	(0.381)
Agricultural Land	-0.105	-0.171	-0.158	-0.123
	(0.664)	(0.448)	(0.470)	(0.474)
Immunisation (measles)	-0.026	-0.022	-0.018	-0.049
	(0.752)	(0.780)	(0.812)	(0.299)
Prenatal care	0.107*	0.108*	0.112*	0.112***
	(0.080)	(0.065)	(0.058)	(0.009)
Rural population	-0.240	-0.270	-0.287	-0.031
	(0.642)	(0.487)	(0.433)	(0.883)
Constant	1.166*	1.073**	1.095***	0.711**
	(0.069)	(0.012)	(0.007)	(0.011)
Time FE?	Yes	Yes	Yes	Yes
Country FE?	Yes	Yes	Yes	Yes
N	157	166	168	153
Within-R2	0.385	0.340	0.353	0.609

Notes: P-values in parentheses, ***, **, * significant on the 1, 5, and 10%-level respectively, probability weights included in every specification. Heteroskedasticity-robust and clustered standard errors applied in every model.

A significant and positive impact of food aid on children's weight could not be found, which indicates that food aid does not have a direct impact on health in the short-run, but might have a positive impact if we observe longer periods. The criticism that U.S. food aid is particularly ineffective in improving health outcomes even has negative effects for well-being could not be confirmed here. The paper shows that much of the criticism discussed in this paper no longer applies for food aid that was provided during the last two decades. However, the effects on the nutritional outcomes are relatively small in size.

Throughout every specification, prenatal care had a significantly positive effect on children's nutritional outcomes. The mother's health therefore seems to be a crucial determinant of her offspring's health. Policy makers and organisations involved in foreign aid should therefore enforce programmes that benefit the mother's health and thereby increase the biological well-being of future generations. A future research desideratum would be to improve the data basis on nutritional outcomes and to find appropriate instruments for food aid, as the lack thereof did not allow the solving of the potential reverse causality problem that arises if food aid is given to countries with high shares of stunted and malnourished people.

Appendix D

Definitions and sources of variables

Food Aid is defined as the share of net official development food aid disbursements and GDP. We only include countries that received food aid at least once during the entire period. Source: OECD DAC 2a data set (aid (ODA) disbursements to countries and regions). Data available at http://stats.oecd.org.

Food Aid L1-5 is the average amount of Food aid/GDP during the period t-1 to t-5.

Food Aid L6-10 is the average amount of Food aid/GDP during the period t-6 to t-10.

Food Aid L11-15 is the average amount of Food aid/GDP during the period t-10 to t-15.

Agricultural Land is the share of land area that is arable. Data: World Bank.

(No) Stunting is the dependent variable and measures the percentage of children under age 5 whose height for age (stunting) is *NOT* more than two standard deviations below the median for the international reference population ages 0-59 months. Therefore, it shows the percentage of children who are *not* stunted. The data are based on the WHO's new child growth standards released in 2006. The variable ranges between 0 and 1, 1 meaning that there is no stunting in the population. Source: World Bank

GDP p.c. is the average GDP per capita in period t. The data was extracted from the World Bank, http://data.worldbank.org/indicator.

Health expenditure is the percentage of total government expenditure that is spent on public health measures. Data: World Bank

HIV measures the percentage of the population (ages 15-49) infected with HIV. The variable ranges between 0 and 1, 1 being 100%.

Immunisation (measles) is defined as the percentage of children (12-23 months) who received vaccinations before 12 months and is adequately immunised against measles. The variable ranges between 0 and 1, 1 meaning that all children in the country are immunised against measles. Data: World Bank.

Immunisation (dpt) measures the percentage of children (12-23 months) who are adequately immunised against diphtheria, pertussis and tetanus. The variable ranges between 0 and 1, 1 being 100%.Data: World Bank.

Infant mortality is defined as the percentage of infants dying before reaching one year of age in a given year. The variable ranges between 0 and 1, 1 being 100%. Data: World Bank.

Intra-state war is coded as a dichotomous variable adopting the value 1 if an intra-state war took place in given country and period. Intra-state wars are wars that are fought within state borders and include wars between non-government forces and a government (civil war) as well as wars between two non-government forces. Sources: Correlates of War Project: http://www.correlatesofwar.org/.

Political rights defines he extent of political rights in a country as calculated by Freedom House. The Variable is coded from 1-7, 7 being the worst. Data: Freedom House

Rural population is the percentage of people living in rural areas as defined by national statistical offices. The variable ranges between 0 and 1, 1 meaning that 100% are living in rural areas. Data: World Bank.

Table D1: Coverage of data set for Table 5.3 (meaning cases where none of the included variables has missing values)

Country	Frequency	Per cent	Cumulative
Angola	1	0.58	0.58
Argentina	1	0.58	1.16
Armenia	1	0.58	1.74
Azerbaijan	3	1.74	3.49
Bangladesh	7	4.07	7.56
Belarus	1	0.58	8.14
Belize	1	0.58	8.72
Benin	3	1.74	10.47
Bolivia	2	1.16	11.63
Botswana	1	0.58	12.21
Brazil	2	1.16	13.37
Burkina Faso	3	1.74	15.12
Burundi	1	0.58	15.70
Cambodia	1	0.58	16.28
Cameroon	3	1.74	18.02
Central African Republic	2	1.16	19.19
Chad	3	1.74	20.93
Colombia	3	1.74	22.67
Comoros	2	1.16	23.84
Croatia	2	1.16	25.00
Cuba	1	0.58	25.58
Djibouti	1	0.58	26.16
Dominican Republic	4	2.33	28.49
Ecuador	2	1.16	29.65
El Salvador	2	1.16	30.81
Equatorial Guinea	1	0.58	31.40
Eritrea	1	0.58	31.98
Ethiopia	2	1.16	33.14
Gambia, The	2	1.16	34.30
Georgia	2	1.16	35.47
Ghana	3	1.74	37.21

Table D1. (cont.)

Country	Frequency	Per cent	Cumulative
Guatemala	3	1.74	38.95
Guinea	2	1.16	40.12
Guinea-Bissau	2	1.16	41.28
Guyana	2	1.16	42.44
Haiti	3	1.74	44.19
Indonesia	2	1.16	45.35
Jamaica	6	3.49	48.84
Kazakhstan	3	1.74	50.58
Kenya	3	1.74	52.33
Lebanon	1	0.58	52.91
Lesotho	1	0.58	53.49
Liberia	2	1.16	54.65
Madagascar	2	1.16	55.81
Malawi	2	1.16	56.98
Maldives	1	0.58	57.56
Mali	3	1.74	59.30
Mauritania	2	1.16	60.47
Mexico	1	0.58	61.05
Moldova	1	0.58	61.63
Mongolia	2	1.16	62.79
Morocco	2	1.16	63.95
Mozambique	2	1.16	65.12
Namibia	2	1.16	66.28
Nepal	3	1.74	68.02
Nicaragua	2	1.16	69.19
Niger	3	1.74	70.93
Nigeria	3	1.74	72.67
Pakistan	1	0.58	73.26
Peru	2	1.16	74.42
Philippines	2	1.16	75.58
Rwanda	2	1.16	76.74

Table D1. (cont.)

Country	Frequency	Per cent	Cumulative
Senegal	2	1.16	77.91
Serbia	1	0.58	78.49
Sierra Leone	3	1.74	80.23
South Africa	1	0.58	80.81
Sri Lanka	2	1.16	81.98
Sudan	2	1.16	83.14
Suriname	2	1.16	84.30
Swaziland	2	1.16	85.47
Tajikistan	5	2.91	88.37
Tanzania	3	1.74	90.12
Thailand	1	0.58	90.70
Togo	2	1.16	91.86
Tunisia	3	1.74	93.60
Turkey	1	0.58	94.19
Uganda	3	1.74	95.93
Vietnam	3	1.74	97.67
Zambia	3	1.74	99.42
Zimbabwe	1	0.58	100.00
Total	172	100	

Table D2: Variance inflation factors

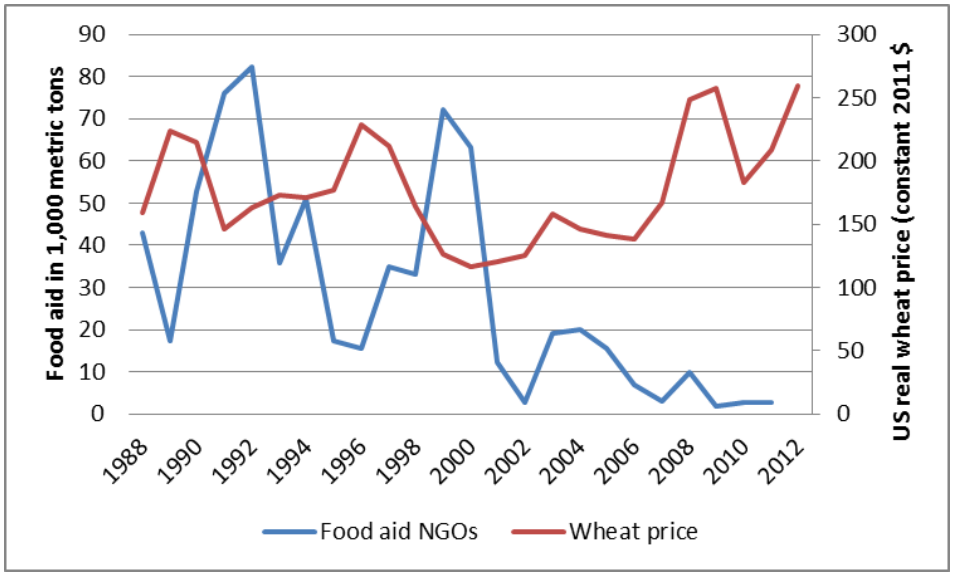
Variable	VIF	1/VIF
Food aid	2.16	0.46
Food aid Lag 1-5	5.06	0.20
Food aid Lag 6-10	3.70	0.27
Food aid Lag 11-15	1.77	0.57
Agricultural land	1.08	0.92
GDP p.c. (log)	4.83	0.21
Health exp.	1.10	0.91
HIV	1.47	0.68
Immunisation (measles)	2.48	0.40
Infant mortality	4.93	0.20
Intra state war	1.15	0.87
Political rights	1.29	0.78
Prenatal care	1.88	0.53
Rural pop.	2.51	0.40
Mean VIF	2.53	

Table D.3: Fixed effects estimation without probability weights

	(1)	(2)	(3)	(4)	(5)
Dep.var.	(no) stunting			(no) malnutrition	
Food aid	-0.690			-2.895**	
	(0.705)			(0.010)	
Food aid Lag 1-5	3.126*	3.452**	2.291*	-0.375	0.798
	(0.087)	(0.022)	(0.093)	(0.626)	(0.123)
Food aid Lag 6-10	-1.026	-0.882	-1.714	0.028	0.006
	(0.358)	(0.419)	(0.100)		
Food aid Lag 11-15	1.544	1.708			
	(0.147)	(0.104)			
Health exp.	-0.087	-0.088	-0.139	0.028	0.006
	(0.625)	(0.613)	(0.417)	(0.781)	(0.949)
Political rights	0.005	0.006	0.005	0.003	0.004
	(0.466)	(0.431)	(0.453)	(0.310)	(0.264)
Intra state war	0.003	0.001	0.001	-0.009	-0.009
	(0.862)	(0.924)	(0.961)	(0.438)	(0.485)
HIV	-0.631	-0.639	-0.594	-0.105	-0.107
	(0.367)	(0.346)	(0.382)	(0.668)	(0.704)
Infant mortality	-0.484	-0.453	-1.187	-1.814**	-2.042***
	(0.730)	(0.747)	(0.324)	(0.030)	(0.009)
GDP p.c. (log)	-0.008	-0.007	-0.008	0.014	0.018
	(0.834)	(0.847)	(0.810)	(0.546)	(0.429)
Agricult. Land	-0.195	-0.202	-0.269	-0.107	-0.128
	(0.443)	(0.428)	(0.279)	(0.470)	(0.454)
Immunisation	0.046	0.048	0.048	-0.062	-0.047
	(0.499)	(0.488)	(0.501)	(0.163)	(0.289)
Prenatal care	0.098	0.096	0.082	0.117***	0.110***
	(0.107)	(0.110)	(0.154)	(0.007)	(0.007)
Rural pop.	-0.136	-0.133	-0.304	0.059	-0.016
	(0.688)	(0.689)	(0.331)	(0.781)	(0.932)
Time FE?	Yes	Yes	Yes	Yes	Yes
Country FE?	Yes	Yes	Yes	Yes	Yes
Constant	0.800**	0.789**	1.002***	0.767***	0.788***
	(0.027)	(0.029)	(0.002)	(0.002)	(0.001)
N	172	172	172	153	153
Within-R2	0.396	0.395	0.370	0.650	0.622

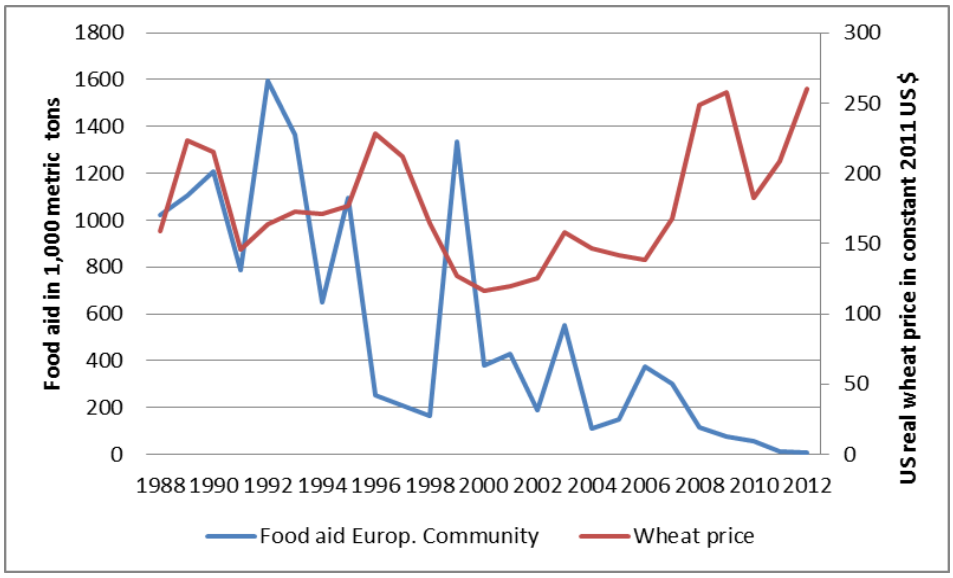
Notes: P-values in parentheses, ***, **, * significant on the 1, 5, and 10%-level respectively, heteroskedasticity-robust and clustered standard errors applied in every model. Fixed effects estimations with equal models as in Table 5.3 and 5.4, but without probability weights.

Figure D1: Wheat prices and food aid given by NGOs



Notes: Data on wheat food shipments are from the World Food Programme (WFP) International Food Aid Information System (INTERFAIS). Nominal prices of U.S. wheat are from the U.S. department of agriculture: http://www.usda.gov/wps/portal/usda/usdahome?navid=DATA_STATISTICS. Real prices were calculated by using the GDP deflator of the World Bank.

Figure D2: Wheat prices and EU food aid flows



Notes: Data on wheat food shipments are from the World Food Programme (WFP) International Food Aid Information System (INTERFAIS). Nominal prices of U.S. wheat are from the U.S. department of agriculture: http://www.usda.gov/wps/portal/usda/usdahome?navid=DATA_STATISTICS. Real prices were calculated by using the GDP deflator of the World Bank.

6. Does food aid really have disincentive effects on local food production? An empirical investigation

Abstract

There has been a persistent belief since Schultz's (1960) seminal paper on U.S. food aid's impact on developing countries that nutritional support leads to disincentive effects for farmers in recipient countries. Moreover, critics argue that repeated food aid flows decrease the recipient government's incentive to invest in agriculture. Both aspects would ultimately lead to a decrease in local agricultural production. The paper investigates, using a global sample, whether there is empirical evidence that food aid does indeed cause a drop in the agricultural output of recipient economies. The results show that the "disincentive hypothesis" cannot be confirmed. On the contrary, nutritional support is significantly related to future wheat production. The total agricultural production, however, is not significantly affected by food aid.

6.1 Introduction

Food aid has aroused heated discussions for more than half a century. As stated in the previous chapter, there are doubts concerning, inter alia, the effectiveness of nutritional support, the right targeting of food aid, and non-developmental donor motivations. A second strand of criticism is related to food aid's unintended consequences for the recipient country's agriculture. More specifically, critics put forward that – by increasing local food supply – nutritional support leads to a drop in local food prices and thereby creates producer disincentives. Moreover, food aid has frequently been accused of shifting the recipient government's investments away from the agricultural sector and displacing commercial imports (Lavy 1990; Lowder 2004, among others). In contrast, some economists argue that food aid can act as a budget relief and could therefore increase spending on locally produced food (Fitzpatrick and Storey 1989) and intermediate goods (Mohapatra et al. 1996), thereby increasing local food production.

This study contributes to a growing body of literature examining the potential disincentive effects of food aid (Abdulai et al. 2003; Barrett 2006; Bezuneh et al. 2003; Lavy 1990; Lowder 2004, among others). Most of the scientific research regarding food aid's impact on recipients' local agriculture is predominantly theoretical in nature and does not provide empirical evidence in favour or against the critical hypotheses. The scant empirical studies on the subject mostly focus on certain countries or on the impacts of food aid on imports and exports. The main objective of this chapter is, in contrast to existing studies, to empirically assess whether food aid really creates unintended effects for the local agriculture. We reach beyond the current state of the art by taking a global perspective, namely by analysing food aid flows to *all* reported recipient countries since the mid-1970s. Furthermore, we also take into consideration that effects might vary between world regions.

Wheat plays an integral role in the distribution of in-kind food aid and also constitutes a major part of monetised food aid. Thus, wheat production will be affected most severely if the disincentive hypothesis holds. The impact of food aid on wheat production in recipient countries will therefore be analysed in detail. However,

nutritional support might also affect the production of other foodstuffs. This is particularly true for countries where wheat is not one of the typical food products. In these countries, local purchases of food or a change of the government's agricultural policy in consequence of repeated nutritional support during times of food shortage would rather affect the production of the main local agri-food products. We therefore also take a closer look at food aid's impact on the total net value of agricultural production.

As the production disincentive effect is one of the most prominent arguments against food aid, the empirical part of the paper will focus on this comprehensive issue. However, the production disincentive argument is inextricably linked with a number of other factors and unwanted effects. Therefore, the points of critique will be discussed in a broader perspective in the following section 6.2. Section 6.3 proceeds with the description of the data and the methodology used, the main results of the empirical analysis are presented in section 6.4. The last section concludes.

6.2 Hypotheses about food aid's impact on agriculture

The first fundamental critique regarding food aid's impact on recipients' agriculture was provided by Schultz (1960). In his study on the U.S. Public Law 480 he discusses his speculative assumption that food aid leads to a drop in food prices and, therefore, results in disincentives for agricultural producers in recipient countries. More recent literature also discusses other potential effects of food aid, such as the displacement of imports, a shift in consumer preferences or disincentives for investment.

6.2.1 Disincentives for farmers

According to Schultz's (1960) influential paper, food aid creates disincentives for recipient countries' farmers because it decreases local food prices, thereby making food production less profitable. In theory, food aid should not serve as a substitution to imports, but must be additional according to the usual marketing requirements (UMR).

This concept, introduced by the Food and Agricultural Organisation (FAO) in the 1950s, requires that recipient countries have to purchase certain amounts of food at non-concessional prices before they can import food aid at concessional prices. Advocates of the disincentive-hypothesis argue that – if the UMR are enforced – food aid will lead to more food supply, resulting in a downward pressure of domestic prices and disincentives for local farmers (Lowder 2004; Lavy 1990). Effects of food aid in cases where UMR are not applied will be discussed in section 6.2.3. Fitzpatrick and Storey (1989) argue that prices do not necessarily fall as a result of food aid. Apart from the case where food aid replaces imports, prices could also remain stable if additional demand is created. This can be achieved by targeting food aid directly to needy people via institutional feeding or other development programs.[104] Moreover, food aid might act as a budget relief for the poor, who tend to spend a high share of their income on food and are likely to consume additional food directly instead of using it as a substitute for locally produced food. As a result, overall demand will increase (Fitzpatrick and Storey 1989). According to Engel's law, however, demand for food does not increase as fast as income (in this case provided in the form of commodities) and therefore the assumption that food aid fosters demand should be regarded with caution (Barrett 2006).

Despite the extensive and adjacent discussion of the topic in literature, empirical evidence on food aid's impact on prices and production disincentives remains scarce. The literature so far does not confirm disincentive effects of food aid (Bezuneh et al. 2003; Lowder 2004; Mabuza et al. 2009; Abdulai and Barrett 2005; Bezuneh et al. 1988) or only displacement of domestic production in the short-run (Barrett et al. 1999, only for U.S. food aid) or at high levels of food aid with more than 10% of domestic production (Tadesse and Schively 2009, for Ethiopia). Moreover, especially small farmers might not even be affected by lower cereal prices as a result of increased cereal availability, as they produce primarily for their own consumption and do not sell their products on domestic markets (McMillan et al. 2007 observe this for Mexican farmers).

[104] Very poor people are assumed not to have access to sufficient levels of food and therefore do not need price incentives to consume more at any given price level if food is available.

Barrett (2006, p.13) and Lavy (1990) argue that potential disincentive effects are offset by positive effects of food aid such as the benefits of reduced liquidity constraints. This finding is an important contribution to the discussion, as it obliterates the argument that food aid's negative impacts are disproportionally felt by the poor who often earn their income in the agricultural sector.

This paper does not intend to judge whether food aid had on average positive or negative effects for different population groups and merely focuses on the general impact on the local agricultural sector. However, it should be kept in mind that while food aid might have negative effects for farmers, other groups of the population could at the same time profit from it. As many poor countries are net importers of cereals, the average household profits from lower food prices even if agricultural products are important export commodities (McMillan et al. 2007). In countries where poor people are more often net buyers than net sellers of wheat, such as Ethiopia, the poor population even profits disproportionally from food aid (Levinsohn and Mc Millan 2007).[105]

6.2.2 Disincentives for the recipient country's government

Food aid is not only criticised for harming net incomes of farmers but also for being fungible and for discouraging government spending on the agricultural sector, as well as dissuading policymakers from necessary policy reforms (Colding and Pinstrup-Andersen 2000, p.194; Maxwell 1991; Maxwell and Singer 1979). According to Kirwan and McMillan (2007), this might be one possible explanation for the fact that many former net food exporters in the developing world have become net food importers. On the other hand, poor countries' food producers might just as well have been the losers of a continuing process of market liberalisation.

Many scholars agree that food aid *does* have adverse effects on policy and institutions (Mosley and Eeckhout 2000, p.135). As far as overall development assistance is concerned, Djankov et al. (2008) even find that it leads to the same rent

[105] There is not much evidence on food aid's direct effects on farmers' households. For the Mexican case, Levinsohn and McMillan (2007) do not find income losses of poor farmers, probably because they very rarely participate in the markets.

seeking behaviour as known in the "curse of natural resources" literature and show that aid is a bigger curse than oil as governments will reduce democracy levels in order to extract more aid flows for own purposes. A similar effect might be assumed for (monetised) food aid.

6.2.3 Food aid as a substitute for commercial imports

Although food aid is intended to be *additional* to commercial imports, it is possible that the UMR cannot always be enforced. If this is the case and food aid therefore works as a substitute for commercial imports, there will be no disincentives for local production as supply does not increase. However, this would just as well be an unwanted effect of food aid. Firstly, because the food supply in the recipient country would stay the same and thus food aid would not help to ease malnutrition. Secondly, because exporting countries (others than the recipient country) would see their export markets eroded if food aid displaced imports (Fitzpatrick and Storey 1989). Recent studies show that an enforcement of the additionality principle is unsuccessful. Food aid displaces commercial imports up to an almost equivalent amount as food aid given (Lavy 1990). Moreover, the displacement was found to be more severe for programme food aid than for targeted aid (Lowder 2004).[106] Barrett et al. (1999) find a J-curve effect on recipient countries' imports, with U.S. food aid resulting in lower imports in the short run but higher imports in the long term. In the Tunisian case, similar import displacement effects have not been found (Bezuneh et al. 2003).

6.2.4 Shift in consumption preferences

Another unintended effect of food aid that is sometimes mentioned in the literature is the possibility of a shift in preferences from locally produced food towards imported food (Coding and Pinstrup Andersen 2000, p.194; Barrett 2006). This can lead to a certain dependence on imports, if foreign food is preferred over local food. Moreover, food-for-work programs that yield direct outcomes for participants – in

[106] Program food aid is usually food that is given to the recipient government which monetizes it and uses it for development project. Targeted food aid is usually directly targeted and freely distributed to poor people.

contrast to own cultivation that is subject to weather conditions – can draw farmers away from their own cultivation (Fitzpatrick and Storey 1989). To sum up, most of the above-mentioned points of critique would – if they were justified – lead to a change in the production pattern. In the following, we will empirically test whether such an effect can be found.

6.3 Data and empirical design

How can food aid influence agricultural output in recipient economies? A theoretical approach on this issue is offered by Mohapatra et al. (1996). The authors assume that an increase in food aid (A) does not only have an effect on food prices (P_f), but also affects budget constraints and the shadow wage of the local producers (P_l).[107] Therefore, the change in output depends on three effects.

$$\frac{dQ_f}{dA} = \frac{\partial Q_f}{\partial P_f} \cdot \frac{dP_f}{dA} + \frac{\partial Q_f}{\partial P_l} \cdot \frac{dP_l}{dA} + \frac{\partial Q_f}{\partial P_x} \cdot \frac{dP_x}{dA}$$

The first term on the right-hand side is the effect of an increase in food aid on local food prices and therefore describes the Schultzian negative partial-equilibrium supply-response (see Schultz 1960): an increase in aid is expected to decrease food prices in the recipient country due to increased food supply, resulting in lower output. However, as mentioned above, food aid can also reduce budget constraints that usually impede imports of intermediate goods (e.g. fertilisers, machinery). Relaxed balance of payments constraints which go along with increased hard currency availability could increase the local supply of commercial inputs and thus reduce the local prices of these goods (Px). This, in turn, could result in increased agricultural output. The effect of increased food aid on the shadow wage is ambiguous as market disincentives and factor market incentives influence the shadow wage in opposing directions. More specifically, the shadow wage is influenced by the induced fall of food prices on the one hand and an

[107] The authors assume that agricultural workers in recipient countries are mostly employed on their own farm and therefore labour is non-tradable. Thus, they receive a shadow wage that differs from the market wage.

increase in leisure demand stimulated by income transfers as well as a fall in intermediate good prices on the other hand.

In summary, the change in agricultural output resulting from an increase in food aid can go either way, depending on whether lower input-factor prices incentivise production to a greater extent than lower food prices disincentivise market output. We empirically test whether food aid significantly affects food production by applying fixed effects models and Arellano Bond dynamic panel GMM estimators, using a large set of explanatory variables that might influence agricultural production. Our data set covers up to 140 countries and 32 years (1976-2008).

The Food and Agricultural Organisation offers a comprehensive data base on agricultural production that provides information both on individual food items and aggregate food production. For the investigation of food aid's impact on wheat production, we use the data on wheat production in tonnes.[108] When food aid's effects for total agricultural production are analysed, we use the net production value of the total agricultural production in constant 2004-2006 international 1,000 $. We use food aid data from the OECD as in the previous chapters and control both for contemporary food aid and previous food aid flows, as it might take a while for farmers to react to changes on the market.

A number of other factors that could influence food production are also controlled for (Table 6.1). We include the share of agricultural land, as countries with high shares of arable land are more likely to produce large amounts of agricultural products. We also control for population size and the share of the rural population because large countries produce larger amounts of food and highly rural societies are often heavily dependent on the primary sector.[109] Civil wars might destroy harvests or keep farmers from cultivating their fields and are therefore included as an explanatory variable as well. As natural disasters are the primary cause for destroyed harvests, they enter the regression as a right-hand side variable, too.

[108] We also ran the regressions with the net production value of wheat in 1,000 international $, which did not change the results. Tables are available from the authors.

[109] The correlation coefficient between total population (log) and rural population is -0.069. Multicollinearity was tested and rejected, therefore we include both variables.

Moreover, we include the explanatory variable "agricultural machinery" in order to account for the technological standard of agricultural production.

The scatter plots showing the relationship between food aid and wheat production or the net value of total agricultural production already provide a first indication of how food aid influences the agricultural sector of recipient economies (Figures 6.1 and 6.2).

Table 6.1: Descriptive statistics

Descriptive statistics for regressions on wheat production					
Variable	Obs	Mean	Std. Dev.	Min	Max
Food aid (in mio.)	987	27.38	53.39	0.01	408.52
Wheat tonnes (in mio.)	987	4.24	15.20	0.00	123.00
Net total food prod. value (in mio).	987	12.30	37.30	0.05	347.00
Agricultural land (% of land area)	987	0.44	0.21	0.02	0.86
Agricultural machinery	987	97.47	141.13	0.08	1083.30
Civil war	987	0.08	0.27	0	1
Natural disasters	987	0.63	0.48	0	1
Population (in mio.)	987	64.50	199.00	0.31	1300.00
Rural pop. as % of total pop.	987	0.60	0.22	0.09	0.97
Descriptive statistics for regressions on total food production					
Variable	Obs	Mean	Std. Dev.	Min	Max
Food aid (in mio.)	1432	22.92	46.66	0.01	408.52
Net total food prod. value (in mio.)	1432	9.67	31.40	0.02	347.00
Agricultural land (% of land area)	1432	0.43	0.20	0.01	0.86
Agricultural machinery	1432	83.89	137.09	0.08	1083.30
Civil war	1432	0.09	0.28	0	1
Natural disasters	1432	0.61	0.49	0	1
Population (in mio.)	1432	51.20	168.00	0.09	1300.00
Rural pop. as % of total pop.	1432	0.61	0.20	0.09	0.97

Notes: Numbers calculated for regressions of Table 6.2, column 1 (for wheat production) and 6.4 column 1 (for total food production), only including cases for which none of the included variables has missing values. Variables that are defined as percentages are divided by 100: a value of 0.5 is therefore equal to 50%.

Figure 6.1: The relationship between food aid and log wheat production (tonnes)

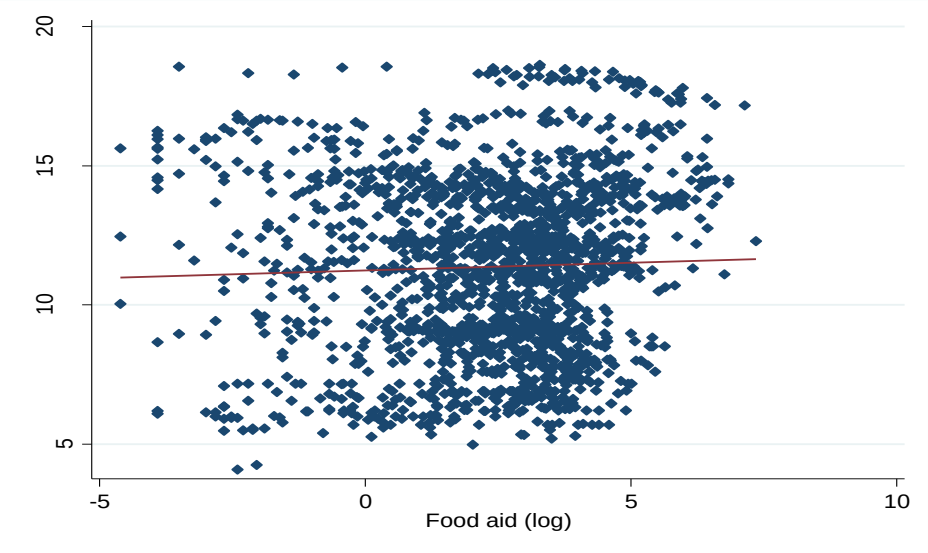
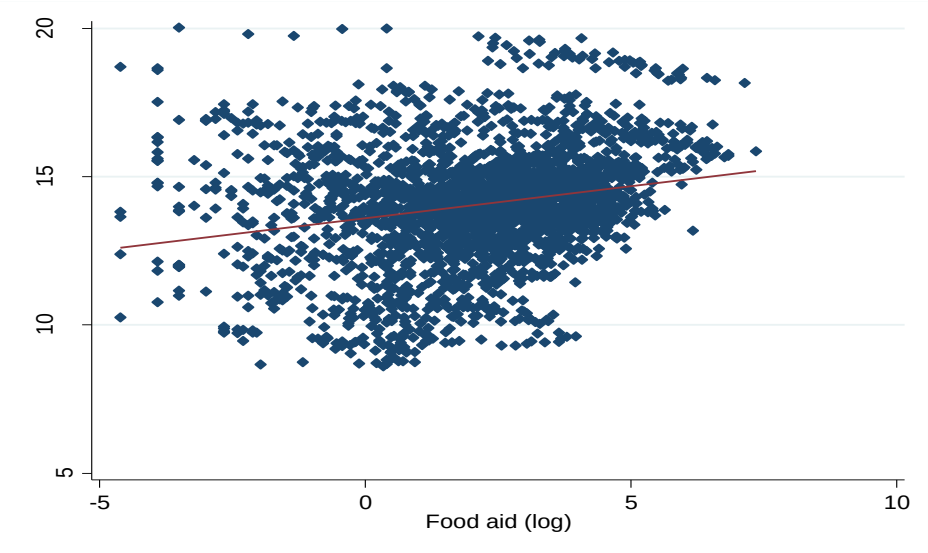


Figure 6.2: The relationship between food aid and the net value of total agricultural production (log)



At first glance, the disincentive hypothesis cannot be confirmed: Figure 6.1 does not indicate a systematic relationship between food aid and wheat production at all. Looking at the net value of total food production, there seems to be a slightly positive correlation with food aid (Figure 6.2). As can be seen in Figure 6.2, large amounts of food aid are mostly given to countries with a high value of total food production, which is not surprising, as countries with a strong focus of agricultural production are also

more likely to face nutritional shortages in the case of a bad harvest. However, the figure also indicates that there is heteroskedasticity, which is why heteroskedasticity-robust standard errors will be applied in each of the regressions.

We use data from the mid-1970s to 2008 for countries that have received food aid at least once. In a first step, we run fixed-effects[110] regressions to measure the impact of food aid on agricultural output:

$$\text{(Log) food production}_{it} = \alpha + \beta_1 \text{(log) food aid}_{it} + B\, X_{i,t} + \eta_t + u_{it}$$

Food production is either wheat production or the total agricultural production value. We analyse the effects of contemporary food aid as well as food aid given in previous periods (which are included in the vector of explanatory variables X) because it might take a while until food aid flows lead to a change in the production behaviour. Country and time fixed effects are included in every fixed effects model. Food aid might have stronger impacts on wheat production in countries where the main agricultural production commodity is wheat. We take this into account by using weighted least squares estimations in some of the specifications, giving more weight to countries with a high share of wheat production relative to total agricultural output.

The panel structure and particularly the fact that we use several lags of food aid as independent variables give rise to the problem auf autocorrelation of the idiosyncratic errors. Serial correlation in linear panel-data models leads to biased standard errors and therefore renders the results less efficient.[111] There are several ways how to deal with this problem. A key concept to be considered is that of the cluster-robust covariance matrix, that is, using standard errors that are robust to heteroskedasticity and allow for arbitrary correlation between errors within clusters of observations (e.g. countries or firms).[112] Peterson (2009) compares the outcomes of different approaches to deal with

[110] We conducted the Hausman test, which rejected the hypothesis that random effects provide consistent estimates. The p-value was 0.000.
[111] We tested for autocorrelation using the approach proposed by Drucker (2003) and found that the assumption that the errors are not serially correlated is violated.
[112] For more detail, see, for example, Wooldridge (2002) or Angrist and Pischke (2009).

serial autocorrelation and finds the most exact and unbiased results for approaches with clustered standard errors.[113]

Newey and West (1987) developed another approach to obtain autocorrelation and heteroskedasticity-robust standard errors. While the Newey-West standard errors were initially designed for serial correlation of unknown form in time-series data, panel versions are available in most of the established statistical software packages. We therefore use fixed effects models with clustered standard errors that are also robust to heteroskedasticity in a first step (Table 6.2), but also compare the results to fixed effects models with Newey-West standard errors for panel data (Table E.2).

Another straight-forward approach to deal with the challenges of dynamic panel data models is to use the Arellano-Bond dynamic panel GMM estimator after Arellano and Bond (1991). We do so in a second step and test whether our results hold. The Arellano-Bond GMM estimator has several advantages. Firstly, time-invariant country-specific characteristics that may be correlated with the explanatory variables are removed by first-differencing. Secondly, a lagged dependent variable is introduced without giving rise to the problem of autocorrelation. Last but not least, we are also able to account for possible endogeneity of food aid. As more aid might be given as a result of strongly reduced food output (for example due to bad harvests or natural catastrophes), a potential endogeneity of contemporary food aid should be taken into consideration. The model can be written as follows:

$$\Delta(\text{Log}) \text{ food prod.}_{it} = \beta_1 \Delta(\log) \text{ food production}_{i,t-1} + \beta_2 \Delta(\log) \text{ food aid}_{it} + \beta_3 \Delta X_{it} + \Delta u_{it}$$

While we assume contemporary food aid to be exogenous in some of the specification, we explicitly declare it to be endogenous in other specifications to see whether our results stay robust. X_{it} also encompasses lagged values of food aid.[114] Again, time fixed effects are controlled for in every specification.

[113] However, he analyses standard errors in panel data sets and clusters at the firm level.
[114] Particularly high levels of food aid are likely to be given in times when food output is low, for example due to bad harvests or natural catastrophes.

6.4 Empirical results

Table 6.2 presents a series of regressions with wheat production (in logs) as the dependent variable. Column (1) to (4) are fixed effects estimations with between one and three lags of food aid or average food aid in the last five years (column 4) in order to account for the possibility that it takes a while for wheat producers to react to food aid provisions. In columns (5) and (6), weights that put greater emphasis on countries with a high share of wheat production relative to total agricultural production are applied. In every specification, contemporary food aid has a negative sign but is only significantly related to a lower production output in one of the specifications (model 3 of Table 6.2). Food aid provided in the previous year has mostly a positive sign, and sometimes significantly so. The negative sign of contemporary food aid might indicate reverse causality. The positive and sometimes significant coefficient of lagged food aid could be interpreted as a sign that production values go back to their growth path after an external shock. According to the within-R^2, the included right hand side variables explain between 25 and 29 per cent of the variation in wheat production, with values increasing once we include more lags of food aid or put more weight on large wheat producers.

In Table 6.3, Arellano Bond dynamic panel GMM estimators are used to test the influence of food aid on wheat production.[115] We include the lagged dependent variable to account for country-specific characteristics with regard to wheat production and also take into account the potential endogeneity of contemporary food aid flows (model 4 of Table 6.3). Not surprisingly, the lagged dependent variable is highly significant and positively related to contemporary wheat production: countries with high agricultural output in the past will also have a higher agricultural output today. The sign of contemporary food aid is negative but insignificant in all specifications. Therefore, the disincentive hypotheses can be rejected, at least for contemporary food aid flows.

[115] For consistent estimation, Arellano-Bond estimators require that the first-differenced disturbances are not serially correlated. We tested this assumption in each of the models, using the Arellano-Bond test for zero autocorrelation in first-differenced errors in Stata. The null hypothesis that there is no autocorrelation was never rejected at orders higher than order 1.

Table 6.2: The impact of food aid on wheat production: fixed effects and weighted least squares estimations

	(1) FE	(2) FE	(3) FE	(4) FE	(5) WLS	(6) WLS
Food aid (logs)	-0.017	-0.023	-0.038*	-0.020	-0.009	-0.014
	(0.401)	(0.254)	(0.091)	(0.277)	(0.729)	(0.581)
L1. food aid (logs)	0.019	0.035**	0.050***		-0.002	0.030**
	(0.349)	(0.040)	(0.006)		(0.897)	(0.015)
L2. food aid (logs)		0.008	0.011			0.015
		(0.630)	(0.369)			(0.342)
L3. food aid (logs)			0.008			
			(0.690)			
Av. Food aid (L.1-5)				0.022		
				(0.614)		
Agricultural land	6.310**	6.482**	6.134**	6.565**	6.076***	5.463**
	(0.027)	(0.027)	(0.019)	(0.021)	(0.003)	(0.014)
GDP p.c. (logs)	0.022	0.020	0.022	0.019	0.009	0.002
	(0.142)	(0.216)	(0.196)	(0.163)	(0.525)	(0.922)
Nat. disasters	-0.061	-0.041	-0.023	-0.063	0.024	0.052
	(0.262)	(0.454)	(0.667)	(0.201)	(0.633)	(0.300)
Civil war	-0.082	-0.111	-0.102	-0.060	-0.016	-0.055
	(0.394)	(0.250)	(0.279)	(0.537)	(0.809)	(0.406)
Rural population	1.950	2.673	3.109	2.215	0.905	1.993
	(0.316)	(0.176)	(0.112)	(0.222)	(0.673)	(0.399)
Agric. machinery (logs)	-0.139	-0.159	-0.216	-0.165	0.274*	0.248
	(0.483)	(0.429)	(0.298)	(0.336)	(0.089)	(0.124)
Population (logs)	0.338	0.106	-0.143	0.628	0.217	0.327
	(0.698)	(0.910)	(0.880)	(0.416)	(0.763)	(0.695)
Time FE?	Yes	Yes	Yes	Yes	Yes	Yes
Country FE?	Yes	Yes	Yes	Yes	Yes	Yes
Constant	2.883	6.590	10.85	-1.840	6.315	4.317
	(0.837)	(0.661)	(0.477)	(0.882)	(0.599)	(0.760)
N	987	905	837	1035	987	905
Within-R^2	0.252	0.271	0.294	0.246	0.278	0.276

Notes: P-values in parentheses, ***, **, * significant on the 1, 5, and 10%-level respectively, heteroskedasticity and cluster-robust standard errors in every specification. Model (5) and (6) are weighted least squares models, with stronger emphasis on countries with a high share of wheat production

Table 6.3: The impact of food aid on wheat production: GMM estimations

	(1) GMM	(2) GMM	(3) GMM	(4) GMM
L1.wheat prod. (log)	0.423***	0.408***	0.411***	0.428***
	(0.000)	(0.000)	(0.000)	(0.000)
Food aid (logs)	-0.012	-0.023	-0.011	-0.014
	(0.463)	(0.120)	(0.502)	(0.455)
L1. food aid (logs)	0.025*	0.044***		0.024*
	(0.058)	(0.001)		(0.100)
L2. food aid (logs)		-0.011		
		(0.301)		
Av. Food aid L1-5			0.001	
			(0.975)	
Agricultural land	1.986	2.580*	1.939	2.063
	(0.148)	(0.074)	(0.152)	(0.122)
GDP p.c. (logs)	0.027**	0.024**	0.028***	0.026***
	(0.012)	(0.037)	(0.009)	(0.006)
Nat. disasters	0.002	0.020	0.001	0.000
	(0.957)	(0.493)	(0.984)	(0.986)
Civil war	-0.051	-0.063	-0.034	-0.052
	(0.321)	(0.250)	(0.531)	(0.312)
Rural population	0.972	0.908	0.705	1.042
	(0.316)	(0.385)	(0.498)	(0.291)
Agricultural machinery (logs)	-0.176	-0.176	-0.176	-0.165
	(0.184)	(0.221)	(0.194)	(0.200)
Population (logs)	0.695	0.441	0.696	0.681*
	(0.130)	(0.395)	(0.138)	(0.095)
Time FE?	Yes	Yes	Yes	Yes
Country FE?	First diff.	First diff.	First diff.	First diff.
Constant	-5.619	-1.349	-5.201	-5.536
	(0.460)	(0.875)	(0.500)	(0.412)
N	895	829	922	895
Chi-squared	1349.9	1616.5	898.2	1453.8

Notes: P-values in parentheses, ***, **, * significant on the 1, 5, and 10%-level respectively, heteroskedasticity and cluster-robust standard errors in every specification. Model (1) to (3) use food aid as exogenous variable, while in model (4) it is assumed that food aid is endogenous.

Food aid provided in the previous year is significantly and positively related to wheat production (columns 1, 2 and 4 of Table 6.4), while average wheat flows during the previous five years do not have a significant effect on wheat output (column 3 of

Table 6.3). We can therefore conclude that the often stated criticism that food aid discourages agricultural production cannot be proven empirically. But do the positive and significant results for lagged food aid indicate that nutritional support significantly increases wheat production in recipient economies (with a slight delay)? A cautious interpretation appears warranted: as food aid is often provided in times of severe food shortage – for example due to an exceptionally bad harvest – a significantly positive relationship between lagged food aid and contemporary wheat production might simply be a sign that production is back on track.

How does food aid influence total food production? Table 6.4 shows the results for fixed effects (column 1) and Arellano Bond GMM estimations (column 2, 3 and 4).[116] The coefficient for contemporary food aid has also a negative sign here, but is only significant in the fixed effects regressions. This is not surprising, as food aid is mostly given in times of severe food shortages which often go along with bad harvests. Moreover, previous years might have been equally marked by low production output and therefore by higher nutritional support. As GMM specifications allow us to include lagged dependent (and independent) variables without running the risk of autocorrelation and can cope with potential endogeneity, they are actually the better option to approach the research question in this paper and should therefore be regarded as the preferred estimation method. Once first differences are applied, the coefficients for contemporary food aid flows are insignificant. The same is true for food aid that is lagged by one year. Moreover, the coefficients for contemporary and lagged values of food aid are very small in size or even zero. It can therefore be said that there is no clear indication for food production disincentives resulting from nutritional support.[117]

[116] We also tested for other specifications with more lags of food aid just as in table 4.2 and 4.3. As the results stayed the same, we only display a selection of these results. However, the tables are available from the authors.

[117] We also conducted regressions controlling for food imports for all specifications testing food aid's effect on wheat production and general food production. Including food imports did not change the results, except for the fixed effects regressions in Table 6.4, where the coefficient for lagged food aid turned insignificant. However, as the sample size is reduced to a great extent if this control variable is included, we decided to use the regressions excluding it as we would otherwise face a bigger risk of sample selection bias. The tables are available from the authors, though.

Table 6.4: The impact of food aid on total agricultural production: fixed effects and GMM estimations

	(1)	(2)	(3)	(4)
	FE1	GMM	GMM4	GMM5
L1.net total agric. value		0.431***	0.405***	0.431***
		(0.000)	(0.000)	(0.000)
Food aid (logs)	-0.010**	-0.002	-0.003	-0.001
	(0.018)	(0.421)	(0.342)	(0.806)
L1. food aid (logs)	-0.009**	0.002		0.000
	(0.022)	(0.604)		(0.941)
Av. Food aid L1-5			-0.004	
			(0.468)	
Agricultural land	2.139***	1.177***	1.244***	1.175***
	(0.000)	(0.001)	(0.000)	(0.001)
GDP p.c. (logs)	0.009	0.008***	0.007**	0.008***
	(0.133)	(0.009)	(0.019)	(0.009)
Nat. disasters	0.001	0.002	0.001	0.002
	(0.838)	(0.656)	(0.835)	(0.740)
Civil war	0.037	0.006	0.007	0.005
	(0.104)	(0.646)	(0.565)	(0.674)
Rural population	-1.088	-0.811**	-0.919**	-0.831**
	(0.106)	(0.042)	(0.031)	(0.039)
Agricultural machinery (logs)	0.091***	0.035**	0.040**	0.034**
	(0.000)	(0.037)	(0.018)	(0.038)
Population (logs)	0.425**	0.232*	0.224*	0.236*
	(0.024)	(0.059)	(0.098)	(0.057)
Time FE?	Yes	Yes	Yes	Yes
Country FE?	Yes	First diff.	First diff.	First diff.
Constant	7.204**	4.386**	4.998**	4.324**
	(0.018)	(0.028)	(0.020)	(0.034)
N	1432	1301	1340	1301
Within-R^2	0.777			
Chi-squared		3886.2	3753.9	3869.1

Notes: P-values in parentheses, ***, **, * significant on the 1, 5, and 10%-level respectively, heteroskedasticity and cluster-robust standard errors in every specification. Model (1) to (3) use food aid as exogenous variable, while in model (4) it is assumed that food aid is endogenous

6.5 Conclusions

In this study, we contributed to a growing body of literature on food aid's impacts on recipient countries' agricultural output by empirically testing the "disincentive hypothesis". That is, we assessed whether there is empirical proof for the frequent statement in – mostly theoretical – literature that food aid leads to disincentive effects for recipient countries' agricultural output.

As wheat plays a crucial role in nutritional support, the effects of food aid on wheat output were tested in a first step, also taking into account that large wheat producers might be more heavily affected by large amounts of food aid given. In a second step, food aid's impact on total food production was tested, as food aid provisions could also affect the production of food commodities other than wheat. Moreover, frequent nutritional support could lead to disincentives for recipient governments to invest in the local agriculture and therefore negatively affect total agricultural output.

The results show that disincentive effects of food aid cannot be found for recipients of food aid since the mid-1970s. On the contrary, the regression analysis that assesses how food aid affects wheat output shows that there is a positive and mostly significant relationship between food aid and wheat output one year after the aid was provided. As food aid is generally given in times of severe food shortage and, moreover, the coefficients are significant but relatively small in size, we abstain from saying that food aid actually leads to a higher wheat output in the future. It might be more reasonable to conclude that food aid does not lead to less output in the future but helps local wheat producers to get back to a normal growth path. The value of total food production was not significantly affected by nutritional assistance.

In summary, we conclude that no empirical evidence can be found for the frequent criticism of economists, accusing food aid of leading to agricultural disincentives in recipient countries. As many doubts relating to food aid's impacts on the agricultural sector remain, it would be interesting to analyse these points of critique empirically in the future. This is particularly true for the impact on agricultural spending of recipient governments.

Appendix E

Definition and sources of variables

Agricultural land refers to the share of land area that is arable, under permanent crops, and under permanent pastures. Arable land includes land defined by the FAO as land under temporary crops (double-cropped areas are counted once), temporary meadows for mowing or for pasture, land under market or kitchen gardens, and land temporarily fallow. Land abandoned as a result of shifting cultivation is excluded. Land under permanent crops is land cultivated with crops that occupy the land for long periods and need not be replanted after each harvest, such as cocoa, coffee, and rubber. This category includes land under flowering shrubs, fruit trees, nut trees, and vines, but excludes land under trees grown for wood or timber. Permanent pasture is land used for five or more years for forage, including natural and cultivated crops. Source: World Bank, World Development Indicators.

Agricultural machinery refers to the number of wheel and crawler tractors (excluding garden tractors) in use in agriculture at the end of the calendar year specified or during the first quarter of the following year. Arable land includes land defined by the FAO as land under temporary crops (double-cropped areas are counted once), temporary meadows for mowing or for pasture, land under market or kitchen gardens, and land temporarily fallow. Land abandoned as a result of shifting cultivation is excluded. Source: World Bank, World Development Indicators.

Civil War is coded as a dichotomous variable adopting the value 1 if an intra-state war took place in given country and period. Intra-state wars are wars that are fought within state borders and include wars between non-government forces and a

government (civil war) as well as wars between two non-government forces. Sources: Correlates of War Project: http://www.correlatesofwar.org/.

Food aid is development food aid in millions of constant 2010 US $. We only include countries that received food aid at least once during the entire period. Source: OECD DAC 2a data set (aid (ODA) disbursements to countries and regions). Data available at http://stats.oecd.org.

GDP p.c is gross domestic product divided by midyear population. GDP is the sum of gross value added by all resident producers in the economy plus any product taxes and minus any subsidies not included in the value of the products. It is calculated without making deductions for depreciation of fabricated assets or for depletion and degradation of natural resources. Data are in constant U.S. dollars (original data in constant 2005 U.S. $. For this paper the data was rescaled into 2010 U.S. $.). Source: World Bank, World Development Indicators.

Natural disasters is a dummy variable with dis=1 if a natural disaster took place in country i and period t. Source: EM-DAT, the international disaster database. Data available at http://www.emdat.be/.

Population refers to the total population. Source: World Bank, World Development Indicators.

Rural population (% of total population) refers to people living in rural areas as defined by national statistical offices. It is calculated as the difference between total population and urban population. Source: World Bank, World Development Indicators..

Total agricultural food production refers to the Net Production Value of the total agricultural production in constant 1000 I$. Source: FAOSTAT (Food and

agriculture organisation of the United Nations, Statistics division). Data available at http://faostat.fao.org/

Wheat production refers to the production of wheat in tonnes. Source: FAOSTAT (Food and agriculture organisation of the United Nations, Statistics division). Data available at http://faostat.fao.org/

Table E.1: Variance inflation factors

Variance inflation factors in cases where the dependent variable is (log) wheat production		
Variable	VIF	1/VIF
Food aid	3.29	0.30
L1. food aid (logs)	4.07	0.25
L2. food aid (logs)	4.09	0.24
L3. food aid (logs)	3.30	0.30
Agricultural land	1.16	0.87
Nat. disasters	1.23	0.81
Civil war	1.07	0.94
Agricultural machinery (logs)	1.67	0.60
GDP p.c. (logs)	1.26	0.79
Population (logs)	1.37	0.73
Rural population	2.04	0.49
Mean VIF	2.23	
Variance inflation factors in cases where the dependent variable is (log) total agricultural production		
Variable	VIF	1/VIF
Food aid	3.20	0.31
L1. food aid (logs)	4.03	0.25
L2. food aid (logs)	4.15	0.24
L3. food aid (logs)	3.31	0.30
Agricultural land	1.10	0.91
Nat. disasters	1.21	0.83
Civil war	1.10	0.91
Agricultural machinery (logs)	1.51	0.66
GDP p.c. (logs)	1.21	0.83
Population (logs)	1.36	0.74
Rural population	1.71	0.58
Mean VIF	2.17	

Table E.2: Fixed effects regressions using Newey-West standard errors

	(1) FE	(2) FE	(3) FE	(4) WLS	(5) WLS
Food aid (logs)	-0.017	-0.023	-0.038*	-0.009	-0.014
	(0.345)	(0.232)	(0.060)	(0.695)	(0.531)
L1. food aid (logs)	0.019	0.035**	0.050***	-0.002	0.030**
	(0.301)	(0.029)	(0.003)	(0.902)	(0.060)
L2. food aid (logs)		0.008	0.011		0.015
		(0.627)	(0.422)		(0.405)
L3. food aid (logs)			0.00798		
			(0.679)		
Agricultural land	6.310***	6.482***	6.134***	6.076***	5.463***
	(0.002)	(0.002)	(0.003)	(0.000)	(0.006)
GDP p.c. (logs)	0.022*	0.020	0.022*	0.009	0.002
	(0.053)	(0.115)	(0.099)	(0.439)	(0.911)
Nat. disasters	-0.061	-0.041	-0.023	0.024	0.052
	(0.194)	(0.381)	(0.634)	(0.621)	(0.268)
Civil war	-0.082	-0.111	-0.102	-0.016	-0.055
	(0.227)	(0.122)	(0.154)	(0.817)	(0.465)
Rural population	1.950	2.673*	3.109**	0.905	1.993
	(0.149)	(0.061)	(0.038)	(0.548)	(0.239)
Agric. machinery (logs)	-0.139	-0.159	-0.216	0.274**	0.248**
	(0.270)	(0.223)	(0.114)	(0.018)	(0.037)
Population (logs)	0.338	0.106	-0.143	0.217	0.327
	(0.589)	(0.876)	(0.843)	(0.704)	(0.631)
Time FE?	Yes	Yes	Yes	Yes	Yes
Country FE?	Yes	Yes	Yes	Yes	Yes
Constant	3.182	11.84	8.937	1.377	-0.845
N	987	905	837	987	905

Notes: P-values in parentheses, ***, **, * significant on the 1, 5, and 10%-level respectively, Newey-West standard errors for panel data applied in every specification.

7. Summary and policy recommendations

The aim of this thesis was to assess different developmental aspects in a global and historical perspective by using an alternative, non-monetary approach to well-being. Moreover, the impacts and the effectiveness of foreign aid as a tool to reduce absolute and relative deprivation were analysed in this context. After introducing fundamental concepts, ideas, and research questions in the first chapter, chapter two was dedicated to the historical development of educational inequality during the 18th to 20th centuries, with a particular focus on the role of globalisation in increasing or reducing the educational gap between the rich and the poor. While the analysis focused on Latin American educational inequality during the First Era of Globalisation (1850-1913), a broader set of developing countries was looked at for the mid- to late-20th century. The empirical results show that the First Era of Globalisation was characterised by increasing educational inequality, while 20th century globalisation led to a reduction in educational inequality. Moreover, there is strong evidence for a modified Kuznets' inverted U hypothesis: educational inequality was rising with GDP per capita until 1913 and fell with GDP per capita after 1945.

Inequality also played a significant role in the subsequent chapter: the determinants of civil war onset were assessed empirically for a global sample since 1816. In particular, we evaluated whether countries with unequal living conditions were more likely to be hit by a civil war. Previous studies on civil war risk had difficulties in empirically examining the effect of inequality on civil unrest as data on traditional indicators of inequality, such as Gini coefficients, are often scarce, particularly for the poor and conflict-struck regions in the world. In this thesis, an innovative approach for measuring inequality was introduced by using the inequality of human height, which is closely related to inequality in monetary welfare. Inequality was identified as a main force driving the onset of civil conflicts, being even more decisive than absolute poverty levels.

We can draw several conclusions from the results of chapters two and three. First, educational inequality has evolved due to external factors and is *not* an established fact that cannot be tackled. Second, globalisation in the 20th century has not harmed educational outcomes in developing countries but has probably even been development enhancing. Last but not least, if inequality (in well-being) is *not* reduced, it might

trigger new violent conflicts, leading to a (further) destabilisation of the respective country and probably even to a vicious circle of inequality, poverty and violence.

One possibility to fight inequality and poverty in general is to provide foreign aid to developing countries. Whether foreign aid has turned out to be an efficient development tool or rather produced unwanted effects was examined in chapters four, five, and six. While the first of these three chapters explored the impact of overall development assistance on well-being, the subsequent chapters offered a detailed insight into the effects of nutritional support, i.e., food aid.

In chapter four, the impacts of overall foreign development assistance provided between the 1960s and late-2000s on the biological standard of living were assessed for a global sample. While a large strand of literature has already provided empirical evidence that aid has weak or even negative impacts on economic growth (Boone 1996; Hansen and Tarp 2001; Easterly et al. 2004, among others), this thesis contributes to the discussion by showing that similar effects can be found for anthropometric outcomes for certain time periods: the results indicate that aid had significantly negative effects on well-being in the short-run during the 1960s to late-1970s. However, an equally negative impact of overall aid on anthropometric indicators was not found for later periods. In the long run, increases in aid flows were even positively related to well-being outcomes, but not significantly so. The change from significantly negative impacts of overall aid until the late-1970s to neutral effects in later periods can partly be attributed to the change in policy designs that increased the efficiency of foreign aid. However, positive impacts resulting from an improved policy design of development assistance seem to be offset by adverse effects evoked, for instance, by rent-seeking behaviour.

The subsequent two chapters took a closer look at sector-specific aid that was aimed directly at guaranteeing food security in developing countries. In a first step, we assessed whether food aid was able to create the desired effect of improving nutritional outcomes (chapter 5). Food aid flows provided between 1995 and 2010 were therefore analysed for a global sample with regard to their impact on children's height and weight, key measures of the impact of food aid on human well-being. The results provided evidence that food aid was significantly and negatively related to stunting for the period under observation. However, a clear causal direction could not be identified

due to a lack of suitable instruments for food aid and the missing possibility of using GMM models as a result of the data structure.

Finally, chapter six analysed whether there is empirical evidence for the persistent belief that food aid causes disincentives for recipient countries' agricultural production. More precisely, it has often been claimed that food aid increases food supply, thereby leading to a decrease in food prices which makes food production unprofitable for farmers. Moreover, repeated nutritional support is believed to create disincentives for the government to invest in the agricultural sector. The results did not confirm the "disincentive hypothesis". On the contrary, nutritional support was found to be significantly related to future wheat production, while no significant food aid effects were found for the total agricultural production. In summary, chapter five and six contribute to the aid effectiveness literature by showing that the mostly negative presumptions concerning food aid cannot be underpinned by empirical evidence.

What conclusions can be drawn from this thesis and which policy recommendations should be derived on the basis of the results provided here? First of all, it has been shown that inequality is not an inevitable fate but has grown historically and can therefore be combatted. Second, if inequality is *not* reduced, it could significantly trigger political destabilisation. One tool to fight inequality is foreign development assistance: chapter four to six have shown that foreign aid and, in particular, food aid is better than its reputation. Moreover, the results suggest that foreign aid has become more effective in tackling underdevelopment due to more intelligently-designed aid policies. A key conclusion that can be drawn from this thesis is therefore that it is not enough to simply increase the amount of foreign aid, as Jeffrey Sachs (2005) requested in his bestselling book "The End of Poverty: Economic Possibilities of our time". Rather, it seems to be essential to improve the efficiency of foreign aid by reducing the risk of fungibility, rent-seeking-behaviour, corruption, and wrong targeting.

Future research should aim at finding suitable instruments for food aid and improve the data base for anthropometric indicators to be able to address the question of causality.

8. References

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