Food Security and

Preferential Trade Agreements

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ABSTRACT

Different disciplinary lenses condition the views on whether trade is generally seen as an opportunity for or threat to food security. Until now there is no consensus on the (empirical) impact in the literature.

First, I analyse the impact of PTAs on food security across 93 low and middle income countries for 1990-2014. To take into account some of the multifaceted heterogeneity across PTAs, a distinction is made between Regional and Bilateral Trade Agreements (RTAs and BTAs, respectively) as these are designed differently in the light of food policy. Findings indicate that having a PTA in force, in contrast to having none, is associated with better food security outcomes. However, an increase in the number of BTAs, which are more competitive, is negatively, and an increase in the number of RTAs, which are more cooperative, is positively associated with food security outcomes in low and middle income countries.

Second, I look into how RTAs and food security are associated across the three sub-regions of Sub-Saharan Africa, Latin America and South East Asia. To take into account heterogeneity across the RTAs I operationalise provisions on food security and related provisions in the agreement texts. I first test the impact of the aggregate provisions on food security for 67 low and middle income countries which are member of at least one of the RTAs in the three sub-regions, 1990-2014. Results indicate that the more food security related provisions a country

has across its RTAs, the better it is a for food security outcomes. Then I test whether the state of food security affects the design of a RTA. Estimates indicate that the more severe the state of food insecurity within a country, the more food security related provisions the country has across its RTAs.

In conclusion, RTAs are potentially an opportunity for food security - and the more food security and related concepts are addressed in the agreement text, the greater the opportunity. In contrast, BTAs are potentially a threat to food security.

DEDICATION

This work is dedicated to those who are restricted from having sufficient and adequate food to enjoy a healthy life style and well-being. It is also dedicated to the many people working on growing and/or providing food, who often belong to the the ones who do not have enough food for themselves.

STATEMENT ON RESEARCH INTEREST

This PhD research is the outcome of a journey I was set on when I interned at the Delegation of the European Union to Korea, at a time when the Free Trade Negotiation between the European Union (EU) and South Korea were in preparation. I contributed to the preparations but left South Korea before the negotiations began to write my Economics MSc dissertation in Germany. Being intrigued and curious about the impacts of such a trade agreement, I chose to write my dissertation on the economic impacts of a Free Trade Agreement between the EU and South Korea.

Not too long after I submitted my MSc thesis, I received an email from the Delegation asking me, whether I would like to work for them as Trade Advisor and support their work for the negotiations. I accepted the offer. And I am very grateful for these experiences, as these gave me insight into the realities of policy making, diplomacy and bureaucracy. Very soon I started to have many questions particularly on the regulations of trade which went beyond my professional task. With my then knowledge I thought that further concepts beyond seemingly economic reasoning, such as human rights, are needed as an integral part to balance the politics of trade regulations. Therefore, I came to the University of Essex to study Law and Human Rights. During this degree I had again the chance to follow my research interest and I looked into the 'relations' between the International Human Rights and International Trade Regime with regard to the Right to Food (LLB Dissertation).

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CONTENTS

List of Figures

LIST OF TABLES

CHAPTER 1

INTRODUCTION

"It is in exchanging the gifts of the earth

that you shall find abundance and be satisfied.

Yet unless the exchange be in love and kindly justice,

it will but lead some to greed and others to hunger."

Kahlil Gibran (1923)

General Research Question

Food insecurity in terms of absolute figures of undernourished people as estimated by the Food and Agriculture Organization of the UN (FAO) has remained prevalent. About 98 percent of the estimated 795 million undernourished people in 2014-16 live in developing[1] countries (FAO 2015).[2] While under five year old child mortality, another food insecurity indicator, decreased globally by about 53 percent from 1990 to 2015, the mortality rate accounts for still 76 deaths per 1000 live births in low income countries, which is approximately 11 times the average in high income countries.[3] In most developing countries, more than

[1] Unless I make reference to a source which makes use of the terms 'developing' and developed', I prefer the terms 'low and middle income' over 'developing' and 'high income' over 'developed', as these are, in my view, more accurate.

[2] According to the 2015 estimates (based on modified method) of the FAO, as published in The State of Food Insecurity in the World 2015, p. 8. See also FAO (2010) for previous estimates that indicate an increasing trend of undernourishment since the mid 1990. See also Hickel (2016) for a discussion on FAO's modified figures.

[3] See WHO, GHO data.

half of the population live in rural areas and the majority's individual income depends on agriculture. Farmers, and particularly small-scale farmers, belong to the group where food is most insecure.

Factors contributing to or countervailing food security outcomes are multiple and conditioned by regional history, culture, economy, infrastructure, geo-political setting and climate. Based on the notion of self-sufficiency and the theoretical classical argument of welfare gains though increased trade, regional trade cooperation and integration is often understood as way of enhancing food security goals. In other words, the governance of international trade in agricultural goods can be a contributing factor to the state of food security across countries.

Trade in agricultural goods has been increasingly liberalised via amongst others multilateral and preferential trade agreements (PTAs),[4] in particular since the mid 1990s. However, the impact of those trade agreements on food security has remained unclear in theory and practice. The relationship between trade (liberalisation) and food security (right to food in particular contexts) has been discussed across the literature through multiple disciplinary and methodological lenses. The different lenses condition the views on whether trade is generally seen as an opportunity or threat for food security in theory (normative debate). The opportunity front is often grounded on primarily neo-classical economic theory which demonstrates efficiency gains via liberalisation; ultimately leading to improved food security. On the threat front, the different disciplines developed arguments by combining theory with observations in practice. Accordingly, the trade regime is influenced by power realities and the implications of this system are outlined in the dependency theory. In other words,

[4]Please note, that different from the WTO terminology, I use the wording preferential trade agreements as an umbrella term for any trade agreement that is not a WTO agreement (but governed by WTO law in most cases), and therefore preferential to the multilateral trading system (see Appendix B.1 for details and comparative overview of terminology). See also Johns and Peritz (2015).

the dependency theory depicts/includes amongst others the asymmetry argument of trade relations. The implications of such an asymmetric trade regime are the macro conditions which contribute to the individual violation of the human right to food of small scale farming families, as argued by human rights scholars and practitioners. The empirical literature has extensively dealt with the implications of liberalisation on economics growth (yet, remained inconclusive) but has neglected to further examine empirically the links between trade agreements as such and its impacts on a coherent food security proxy across countries. A more detailed review of the theoretical and empirical literature is outlined in Chapter 3.

This gap in the literature motivates my general overarching question: How are food security and trade agreements associated? Before elaborating on my more specific research question how are PTAs associated with food security, I describe the multilateral trade regime in the light of food security and in relation to PTAs. I do so in order to set the general research question in context and to highlight the relationship between PTAs and the WTO with regard to the impact on food security.

The Trade Regime

The current multilateral trading system has its origin in trading rules named the General Agreement on Tariffs and Trade (GATT), which were negotiated in the aftermath of World War II and signed in 1947. These rules aiming trade liberalisation for goods "reflected closely the original US vision of the broad-based elimination of quantitative restrictions, combined with the progressive reduction of tariffs" of goods and applied in principal also to agricultural trade (Lang 2011:28). The rules contained loopholes with the effect that by the end of the 1970s the three major economies among all GATT Member States, the United States (US), the European Union (EU) and Japan, had de facto excluded agricultural goods from the GATT (Reichert 2009). Unconstrained by the multilateral commitments, states were able to

increase export subsidies to promote their own agricultural market; and this was particularly exploited by the EU, followed by the US and Japan (Kersten 2016).

Given the unsustainable agricultural subsidy race (or "farm wars" as coined by Wolfe (1998)), hegemonic economies agreed[5] that a coordinated approach of agricultural policy was needed (Downes 2007; Reichert 2009) and launched negotiations under GATT, which took place among GATT Member States between 1984 and 1994. This so-called Uruguay Round resulted in the establishment of the World Trade Organisation (WTO) in 1995, incorporating the principles of GATT (WTO Marrakesh Agreement). At the same time a first Agreement on Agriculture was agreed upon its WTO members[6]. In their preambles, the WTO establishing agreement (Marrakesh Agreement 1994) and the WTO Agreement on Agriculture (AoA) make reference to rising living standards and particularly to food security - a then already widely diffused norm. Accordingly, "relations in the field of trade should be conducted with a view to, inter alia, raising standards of living" (Marrakesh Agreement: Preamble).

In detail, under the AoA Member States agreed to three basic commitments: increased market access for agricultural products via tarification of all border protection measures and subsequent progressive lowering of tariffs (36 percent over 6 years for developed countries, and 24 percent over 10 years for developing countries), cuts in domestic support of farming,[7] and reduction in subsidies for agricultural exports if these existed in 1986-1990 (i.e., mainly relevant for the EU, US and Japan). However, some of the domestic support reduction has been purely cosmetic and/or modifications to previous support were made to be compatible with the allowed exceptions (Swinnen, Olper, and Vandemoortele 2012; Meléndez-Ortiz,

[5] This was very much driven by the US, "which sought to limit EU subsidies to its agriculture sector (which has exploded in the 1980s and were undermining American competitiveness and global market share), as well as to gain better access to European markets" (Hopewell 2016: 68).

[6] As of now 162 states are member to the WTO.

[7] Domestic support is classified in three categories known as the Amber Box, the Blue Box (Amber Box with conditions), and the Green box - the latter two are being exempt from obligatory reductions.

Bellmann and Hepburn 2009; Banga 2015; Downes 2007; Reichert 2009).[8] Furthermore, there was little effect in effectively reducing the agricultural export subsidies of the US, EU and Japan (Hopewell 2016).

Therefore in practice, the multilateral trading system has been arguably more favourable for high income trading partners, in particular the EU, US and Japan, which continued to subsidize their agricultural exports. Given this managed trade system in practice in contrast to a declared trade system in line with economic principles, it can be argued that while the AoA was intended to increase policy space for food security for its members, it did for high income countries who took advantage of the loopholes within the law, but it restrained policy space for the countries who were already struggling to fulfil their food security obligations under international human rights law.

The following WTO round, the Doha (Development) Round, launched in 2001, has been strained by a political power struggle between the EU and the US on the one side, and the economies which learned their lesson from the implications of the previous round on the other side - the low to mid income countries backed by rising economies such as Brazil, India and partly China. The latter have formed groups within the WTO such as the group of 20 (G-20), a Southern bargaining coalition on agriculture, and the Group of 33 (G-33), a coalition of low and middle income countries with agricultural sensitivities (Margulis 2013). During the from time to time sticky and stale, and until today un-concluded Doha Round, these combined forces have been increasingly pressing for the liberal international economic order, which the US rhetorically has claimed to be the principle for the multilateral trading system, to be actually realised by asking it to be more universal and inclusive (Hopewell 2016).

[8] In case of the latter, Blue and Amber Box measures were replaced by Green Box measures which is evidenced by the fact that a decrease in the non-green box category has been accompanied by an increase in the Green Box category ("box shifting") (Swinnen, Olper, and Vandemoortele 2012; Meléndez-Ortiz, Bellmann and Hepburn 2009; Banga 2015).

Thereby, 'agriculture' remains one of the most sensitive, contentious and controversial issue of negotiations (Reichert 2009; Grant 2003, Morrison and Sarris 2007), which also implies negotiations surrounding food security.

On the one hand, the G-20 managed to strengthen their negotiation power by challenging the high income countries' price distorting subsidies in place by turning the rhetoric of free trade and liberalization back on the US and EU (Hopewell 2016), and were then able, partly with the support of the G-33, to push for new trade provisions to support food security by protecting produce grown by resource-poor farmers (Margulis 2013).

On the other hand, under the auspices of the G-33, India led a proposal on public food security purposes[9], which aims to provide subsidised food to the poor and guarantee minimum price support for farmer (Hopewell 2016), just before the 2013 Ministerial meetings in Bali. The proposal was strongly contested by the US during that meeting (Hopewell 2016), and has remained largely unresolved also in the following Ministerial conference in Nairobi end of 2015. Some success was, however, achieved in Nairobi by the low and middle income countries - or generally in terms of trade liberalisation principles. The Nairobi package (declaration), includes the agreement that all developed member countries shall eliminate immediately their remaining export subsidies (as usual with exceptions) and developing member countries by the end of 2018.[10]

To summarise, despite the multilateral agreements texts on raising living standards including food security, the implications of these in praxis have been to the disadvantage of low

[9]See G-33 Proposal on Some Elements of TN/AG/W/4/Rev.4 for Early Agreement to Address Food Security Issues, WTO Doc. JOB/AG/22, November 2012 and JOB/AG/25, December 2013; see also Committee for Agriculture Public Stockholding for Food Security Purposes, Note from the WTO Secretariat, WTO Doc. TN/AG/W/8, January 2015.

[10]WTO Ministerial Conference Tenth Session, Ministerial Decision of 19/12/15, Export Competition, WTO Doc. WT/MIN(15)/45.

and middle income countries. The attempts by relatively food insecure countries to integrate concrete provisions on alleviating food security into the multilateral framework were blocked by leading high income countries. While the multilateral framework might provide the most efficient platform to tackle food insecurity due to power imbalances, any attempts are blocked on the procedural level. The latter demonstrates further the asymmetric power relations among WTO members due to economic inequalities.

Since the establishment of the WTO and its multilateral agreements, no other landmark agreement has been reached on the multilateral level. The slow progress of the ongoing Doha Round is often considered to be one contributing factor to the proliferation of PTAs, which are governed by WTO law on the bilateral and plurilateral/regional level (see, e.g., Grant and Lambert 2008).

By law the PTAs are an exception to the WTO agreements. In detail, it is an exception to the WTO key most-favourite-nation principle which is granted by Article XXIV of GATT and the Enabling Clause, latter agreed upon in 1979 (For trade in services Article V of General Agreement on Trade in Services (GATS)). Under Article XXIV of GATT trading partners can enter into preferential trade agreements if these liberalise "substantially all trade" between them. The enabling clause provides a relaxation of the criteria set in Article XXIV allowing for more flexibility with regards to granted preferences in particular for developing countries (Dür and Elsig 2015). PTAs are not checked for compliance as such (Pauwelyn 2009) and there is no agreement on the interpretation of "substantially all trade" - with the effect that all sorts of PTAs are concluded (Pauwelyn 2009). While it is required by Article XXIV of GATT to include agriculture in the PTAs, there is substantial flexibility (Fulponi 2015), with the effect that agriculture is most often treated differently in these agreements (Josling 2009) including the protection for sensitive products (Fulponi 2015) of particular commercial in-

terest (e.g., sugar for EU, rice for Japan, maize for US).

Given the stale negotiations on agriculture and food security on the multilateral level, PTAs with substantial flexibility can potentially have a more direct effect on countries' state of food security - not only by increasing or redirecting agricultural trade flows but also by creating common regulations, policies and/or institutions which promote food security.

The WTO counts as of February 2016 454 PTA notifications of which 267 are in force.[11] The new generation of PTAs is comprehensive and entails provisions beyond mere tariff and non-tariff barrier reduction for trade in agricultural goods, which affect trade in agriculture, such as sanitary and phytosanitary measures, rules of origin, foreign direct investment, services, government procurement, and intellectual property rights. While these provisions are substantially heterogeneous across PTAs (Kim 2015; Baccini, Dür, Haftel 2015; Baier et al. 2015), these tend to establish deeper integration in comparison with the WTO's agreements (Grant and Lambert 2008) according to some authors.

Nevertheless, agriculture - highly relevant for food security - remains the most excluded or exceptionally treated in bilateral, plurilateral and multilateral trade agreements. The reason lies in the sensitive nature of the agricultural sector and its wider implications for national security (Josling 2009) and food security. Unsurprisingly, agricultural trade remains the most distorted in the world economy (Panagariya 2005), partly, because the domestic agricultural sector is often supported and/or protected from international competitors. This refers especially to bilateral trade agreements (BTAs), which involve two trading partners in the same or not same region, and which tend to be negotiated among often economically unequal trading partners with the apparent mandate to protect and support one's own industry; resulting

[11] The WTO figures correspond to physical PTAs - counting goods, services and accessions together. The total count is 419 if counted separately. See WTO facts and figures on 'regional trade agreements' (WTO terminology).

in 'competitive' design of the agreement text. In contrast, regional trade agreements (RTAs), which have at least three trading partners in the same geographical (sub-)region[12], tend to include provisions on common policy objectives with regards to agriculture and also food security and are therefore considered to be more cooperative.

Specific Research Question

Given the above context of the multilateral trading regime and its inherent power imbalance, I look particularly at the impact of PTAs on food security in low and middle income countries by taking into account the multilateral trading system. To reflect the question on how are PTAs and food security associated in both directions, I then analyse whether the state of food security potentially influences the text of RTAs of low and middle income countries in Sub-saharan Africa, Latin America and South East Asia.

I answer the specific research question in Chapters 2, 3 and 4 and link these as follows. To set the rationale for a coherent food security variable, I discuss the food security concept in detail. In this context I introduce the food security framework, which not only justifies the choice of the food security variable, but also the control variables for the following analysis. Accordingly, my three datasets are based on my own variable selection. Furthermore, I compile my own trade agreement dataset by referring to five different sources in order to retain detailed information on the trade agreements, which have not been operationalised before.

In detail, Chapter 2 discusses at the beginning how the terminology, conceptualization and measurement of hunger has remained inconclusive across the literature. I then contextualise the concept of food security within the applied terminology and develop a theory driven conceptual framework which highlights the multifaceted and multidimensional character-

[12] At least three participating states can be set as a requirement for its definition (Josling 2009, Bese et al. 2009).

istics of food security. The framework suggests to test the following: first, food insecurity is a latent variable which can be measured via multifaceted observable indicators which proxy food insecurity outcomes; and second, further multidimensional indicators co-vary with the latent concept food security. These two propositions are tested with a confirmatory Structural Equations Approach for 114 low and mid income countries in 2010. The results indicate that food insecurity can be modelled as a latent variable with proxies child mortality, child stunting and wasting, anaemia among pregnant women, prevalence of undernourishment and the progressive realisation of the right to food (via a Confirmatory Factor Analysis). Some multidimensional indicators, such as food production, health expenditure, access to sanitation and water, contribute to the explanation of the variation of the latent concept to some degree but overall statistically not sufficiently (Multiple Indicators Multiple Causes Model). In conclusion, to model a latent variable for panel data is due to too many missings of the required data, still not feasible. The framework suggests to then refer to one of the outcome-utilization indicators such as child mortality. The rationale for selecting child mortality as the ideal proxy of food security, as previously done in the literature is outlined in Chapter 3.[13]

In Chapter 3, I estimate the distinct impact of BTAs and RTAs on food security. Before doing so, I provide a literature review on the debate whether trade is an opportunity or threat to food security. In detail, I analyse the impact of PTAs on food security across 93 low and middle income countries for 1990-2014 with a Fixed Effects and Dynamic Panel model by controlling for economic, political, social and human rights variables. To take into account some of the multifaceted heterogeneity across PTAs, a distinction is made between RTAs and BTAs as these are designed differently in the light of food policy. As briefly mentioned above,

[13]The purpose of this Chapter is to discuss the concept of food security in order to identify a workable dependent variable for the following Chapters. At this stage, theories in the context of the concept only are introduced and integrated into the framework. The framework is the main theoretical contribution, which facilitates and justifies the selection of the dependent variable for Chapter 3 and 4.

BTAs are often negotiated among asymmetric trading partners in a competitive manner and result in a more 'competitive' design. In contrast, RTAs often entail common policies or objectives on food security and related concepts, and are therefore in comparison more cooperative. Findings of the empirical analysis confirm that having a PTA in force, in contrast to having none, is associated with better food security outcomes. However, an increase in the number of BTAs is negatively, and an increase in the number of RTAs is positively associated with food security outcomes in low and middle income countries.

In Chapter 4, I build on the impact findings of Chapter 3 and examine RTAs and their association with food security in more detail. After comparatively analysing commonalities and differences of RTAs of three subregions, Sub-Saharan Africa, Latin America and South East Asia, I operationalise a food security provision variable based on a comparative analysis of agreement texts (count of provisions) which controls thereby for heterogeneity of RTAs in the light of food security. To estimate what the impact of these provisions is on food security, I regress food security outcomes on the provision variable for 67 RTA member countries in 1990-2014 with variations of a Dynamic Panel model. To assess factors of RTA design, I fit the same data with a Count model which regresses the provision variable on food security outcomes and employs an instrumental variable 'natural disaster' to control for endogeneity. The results indicate that an increase in the number of provisions can lead to better food security; and that the more severe the lack of food security, the more provisions related to food security are incorporated in the design of the relevant RTA.

Chapter 5 concludes that RTAs are potentially an opportunity for food security - and the more food security and related concepts are addressed in the text, the greater the opportunity. In contrast, BTAs are potentially a threat to food security. These results add to the literature by indicating that trade agreements are not per se a threat or an opportunity for

food security, but need to be further differentiated in light of food security relevant characteristics.

Chapter 2

Hunger Statistics: How to Measure Food In-Security?

Abstract Chapter 2

There is no consensus on the terminology, conceptualization and measurement of hunger across the literature. This Chapter contextualises the concept of food security within the applied terminology and develops a theory driven conceptual framework which highlights the multifaceted and multidimensional characteristics of food security. The framework, which is more coherent, comprehensive and compact than the ones suggested in the literature so far, presents two hypotheses. First, food insecurity is a latent variable which can be measured via multifaceted observable indicators which proxy food insecurity outcomes; second, further multidimensional indicators co-vary with the latent concept food security. The two propositions are tested with a confirmatory Structural Equations Approach for 114 low and mid income countries in 2010. The results indicate that food insecurity can be modelled as a latent variable with proxies child mortality, child stunting and wasting, anaemia among pregnant women, prevalence of undernourishment and the progressive realisation of the right to food (via a Confirmatory Factor Analysis). Some multidimensional indicators, such as food production, health expenditure, access to sanitation and water, contribute to the explanation of the variation of the latent concept to some degree but overall statistically not sufficiently (Multiple Indicators Multiple Causes Model).

Keywords: Food Security / Right to Food / Measuring Latent Variable / Structural Equation Modelling

2.1 INTRODUCTION

'For the first time in human history more than one billion people are hungry worldwide' has been a common slogan in 2010, five years before reaching the 2015 deadline of the Millennium Development Goals. This slogan was backed with the United Nations Food and Agriculture Organization's 2010 estimates of undernourished people as published in the organization's yearly 'State of Food Insecurity' report. The 2013, and then 2015 estimates for the 2010 figure have been successively lowered down to 838 million (2015 estimate for year 2015 is 793 million) just in time for the Millennium Development Goals deadline, partly due to the revised estimation methods.[1]

This raises questions on terminology, conceptualisation and measurement of hunger. First, terminology to depict hunger and/or related concepts has not only been diversely but also incoherently applied within and across academic disciplines and beyond. Attempts to systematize the fuzzy terminology of and surrounding concepts of hunger has brought even more contradiction and thereby confusion to the debate. Second, despite Sen's work on the theory of hunger since the 1980s (Sen 1981 and 1985), there is apart from some limited attempts, no coherent, comprehensive and compact conceptual framework suggested in the literature. Third, there is though consent amongst authors on the observation that the lack of a common terminology and coherent conceptualisation might have contributed to a rather dizzying array of measurement options (Jones et al. 2013).

The contribution of the Chapter is threefold. First, the applied terminology in the literature is compared and contrasted to contextualise a common nominator - the concept of food security. The evolution of the theoretical underpinnings of food security is sketched to define food security by four pillars, namely, availability, access, utilization and stability. To set

[1] See for a critical discussion of FAO's modified figures Hickel (2016).

grounds for the operationalisation of food security, the general idea of different levels of indicators, structural, process and outcome, is introduced thereafter. In the context of the pillars and levels, the most commonly applied food security measures are reviewed. Second, based on the theory of pillars, levels of indicators and indicators review, a conceptual framework, which synthesises the pillars and levels into dimensions, is developed. This is the main theoretical contribution of this Chapter. The theory driven conceptual framework facilitates the identification of indicators and presents two propositions: I) Food insecurity is a latent concept and can be measured via observable multifaceted utilization outcome indicators; and II) indicators of other dimensions contribute to the explanation of the latent variable food security. Third, the two propositions are tested with a Structural Equations Approach. Whilst the first hypothesis can be confirmed via Factor Analysis, a Multiple Indicators and Multiple Cases Model fails to approach the underlying data statistically insufficiently; and therefore the second hypothesis needs further analysis/testing.

2.2 The Concept and Operationalisation of Food Security

2.2.1 Theoretical Foundations and Four Pillars

Terminology to depict hunger or related concepts is diversely applied (Jones et al. 2013). Wording such as undernourishment, undernutrition, malnutrition, hunger and food insecurity are often but not coherently referred to across the literature (Burchi and De Muro 2012). For example the Food and Agriculture Organization of the United Nations (FAO) in line with Drèze and Sen (1989) describes undernourishment as a state of an insufficient intake of food to meet dietary energy requirements resulting in insufficient energy, strength or some other feature associated with nutritional sufficiency (lasting for at least one year) (Drèze and Sen 1989; FAO 2015).

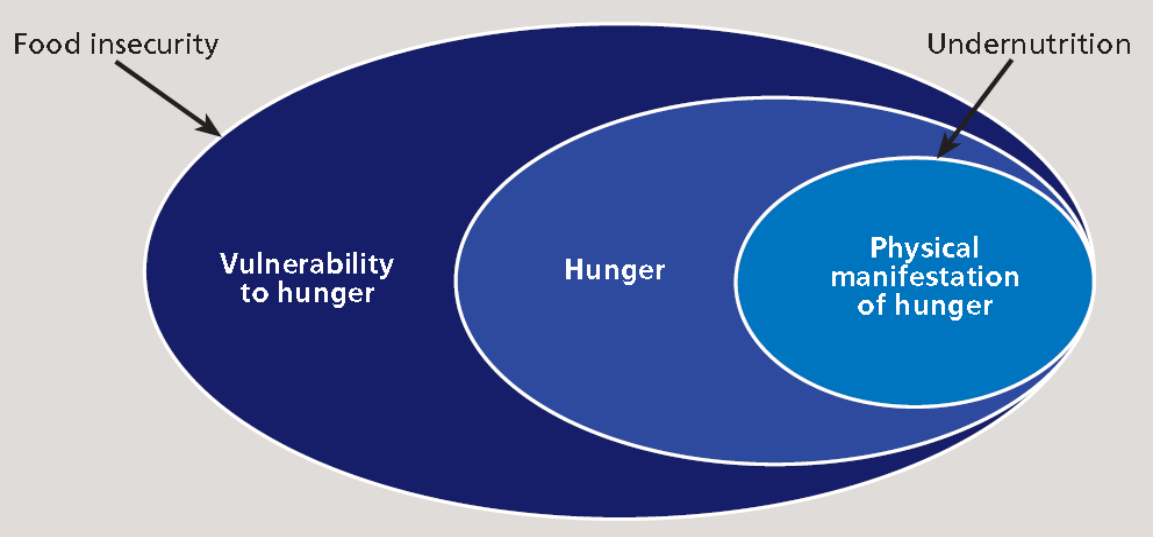
According to Drèze and Sen (1989) undernutrition refers to a situation of a food shortage in terms of quantity or variety; the latter can be described as one aspect of food quality. The FAO (2015) adds that undernutrition can be the outcome of undernourishment but also the outcome of a poor physical absorption and/or use of nutrients (micronutrient deficiency). This includes "being underweight for one's age, too short for one's age (stunted), dangerously thin for one's height (wasted) and deficient in vitamins and minerals (micronutrient malnutrition)" (FAO 2015: p. 53). In addition to undernutrition and micronutrient deficiency malnutrition also encompasses obesity (overnutrition). Whilst hunger is often described as the physical discomfort caused by lack of food (Barrett 2010), the FAO (2015) defines hunger as chronic undernourishment.

The World Food Programme (2009) sets food insecurity, hunger and undernutrition in relation to each other as nested concepts (see Figure 2.2.1).[2] Accordingly, undernutrition is a

[2] See for an illustration of overlapping concepts Figure 1 in Jones et al. (2013). The overlapping illustration is partly contradictory to the here presented nested concepts in Figure 2.2.1 and Figure 2.2.2.

physical manifestation of hunger and a subset of the latter. Hunger is a subset of food insecurity. However, this can contrast with the fact that one can be food insecure without being hungry for example due to micronutrient deficiency.

Figure 2.2.1: Nested Concepts according to the World Food Programme



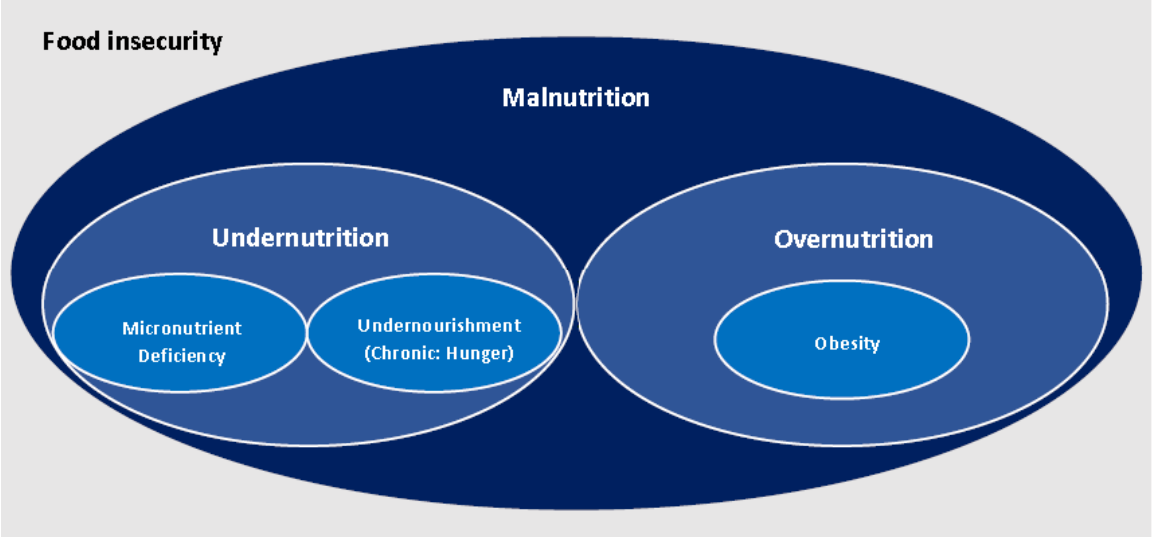
Source: World Food Programme (2009): p. 18.

Therefore, also given FAO's understanding of hunger being chronic undernourishment and undernourishment being one possible consequence of undernutrition (besides micronutrient deficiency), the nested concepts idea is presented in an alternative overview more in line with Drèze and Sen, and FAO's outlining of the concepts (see Figure 2.2.2). Furthermore, the re-nested overview presents well the commonly referred to triple burden of malnutrition: micronutrient deficiency, undernourishment and obesity. Additionally, the term food insecurity, which includes the concept of malnutrition, whereby arguably it might refer to undernutrition only, is included as an overarching concept in the overview.

For the purpose of this Chapter, malnutrition is understood in the sense of undernutrition

only (i.e., overnutrition is not considered). As food (in-)security is the focus in the remainder of the Chapter, the concept is defined and described with more detail in the following. Food security can be understood as a "continuum with food security and food insecurity[3] positioned at opposing ends" (Jones et al. 2013: p. 482). Occasionally, a human rights approach to food security is added on as this perspective provides further comprehensive elaboration on food insecurity, which is relevant for the further analysis. In this sense the rationale is to focus on the substantive interpretation of the right to food rather than on the legal implications of it.

Figure 2.2.2: Re-nested Concepts



Source: Own adaption.

Since the term of food security was introduced in the 1970s (Shaw 2007), its understanding evolved over time. The most commonly referred to definition of food security was introduced during the World Food Summit 1996 and slightly modified in 2001[4]. Accordingly, food security exists when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food that meet their dietary needs and food preferences for

[3] Please note that terms food in-security and food insecurity are used interchangeably.
[4] By adding the wording 'social' (Clapp 2015).

an active and healthy life. Accordingly, the four pillars of food security are 1) availability, 2) access, 3) utilization and 4) stability.

The right to adequate food is an international human right and recognised in the 1948 Universal Declaration of Human Rights (UDHR), as part of the right to an adequate standard of living (Article 25). While it is also referred to in several other instruments under international human rights law (for example, Article 24 and 27 of the Convention on the Rights to the Child), it is most comprehensively dealt with in the 1966 International Covenant on Economic, Social and Cultural Rights (ICESCR). In Article 11(1) of the ICESCR the right to adequate food is recognised as part of an adequate standard of living and is further depicted in Article 11(2) by the wording "fundamental right of everyone to be free from hunger". The United Nations Committee on Economic, Social and Cultural Rights (CESCR), the body of independent experts monitoring compliance with the ICESCR on behalf of the United Nations' Economic and Social Council (ECOSOC), interprets Article 11 in their General Comment No. 12 and provides by doing so also further elaboration on the meaning of food security.

In summary, the right to (adequate) food provides legal entitlements to every individual, either alone or in community with others, to have physical, social and economic access at all times to sufficient, adequate (safe and nutritious) and culturally acceptable food that is produced and consumed sustainably to meet dietary needs and food preferences for an active and healthy life, preserving access to food and to the resources that are necessary for the enjoyment of food security for future generations (FAO and OHCHR 2010; de Schutter 2014). The four pillars for the right to food are titled slightly differently than for the concept of food security, namely 1) availability, 2) accessibility, 3) adequacy and acceptability, and 4) sustainability. As these four pillars are very similar in substance, the wording could be used interchangeably. However, the nuances in terminology are further elaborated upon under

the relevant pillar.

In the following the concepts of food security and the right to food will be comparatively described in the light of these four pillars to contrast but more so to highlight communality and complementarity.

The first pillar, food availability, the understanding of food security in the 1970s (Jones et al.2013; Maxwell 1996), describes the sufficient aggregate supply of food (per capita) through forms of domestic production (minus exports), imports, food stocks and food aid within a country or area (WFP 2009; Burchi and De Muro 2012; Simon 2012). According to the CESCR availability in the context of the right to food "refers to the possibilities either for feeding oneself directly from productive land or other natural resources, or for well-functioning distribution, processing and market systems that can move food from the site of production to where it is needed in accordance with demand" (General Comment No. 12: para. 12). Clearly, the overall economic condition of a country is one of the determining factors for net availability of food. In the context of the right to food, Article 2 of the ICESCR, takes this into account by setting the progressive achievement of the right to food in relation to the maximum of the states' available resources.

In 1981 Sen drew attention to the second pillar (economic) access by highlighting the importance of taking the economic conditions of people 'endowments', the command over entitlements, and 'exchange entitlement' into account (theory of entitlement). Food security cannot be assessed by food availability only which is a necessary but not a sufficient condition (Burchi and De Muro 2012). Therefore, further variables on households' endowments, the bundle of resources people originally own (e.g., land, house, employment), and the 'exchange entitlements', various alternative bundles that the person can acquire through the

use of trade and production starting with each initial endowment (Drèze and Sen 1989) (e.g., information on wages in relations to food and other non-foods prices) need to be additionally taken into account for the assessment of food security (Burchi and De Muro 2012). Sen's entitlement approach is the underlying theoretical concept for the second pillar.

In more detail, food access/accessibility refers to the households' and/or individuals' physical, economic and/or social-cultural ability to access to food. Physical access is determined by amongst others infrastructure and information; economic access describes the households' "financial ability to regularly acquire adequate amounts of food to meet their requirements" (Simon 2012: p. 6); social and/or cultural barriers to the access of food can be experienced by simply belonging to a certain group of the population (e.g., women, disability, non-nationals, indigenous, religious or ethnic groups) (Simon 2012). In the context of the right to food, the latter dimension, has been further elaborated upon in the context of physical accessibility by the CESCR (the Committee differentiates explicitly only between economic and physical accessibility). In their General Comment No. 12, the Committee states that "adequate food must be accessible to everyone, including physically vulnerable individuals, such as infants and young children, elderly people, the physically disabled, the terminally ill and persons with persistent medical problems, including the mentally ill", and "indigenous population groups whose access to their ancestral lands may be threatened" (General Comment No. 12: para. 13). One notable difference between food security and the right to food is the wording. Accessibility emphasises the ability to access in contrast to the mere existence of access. Given the definitions of access and accessibility, there is yet, no difference on the substantial level.

The third pillar, utilization, refers to an individual's "ability to select, take in and absorb the nutrients in food" (WFP 2009: p. 18). Amartya Sen and Jean Drèze refer in this context, in

their 1989 publication, to the capability of individuals "to avoid undernourishment and escape deprivations associated with hunger" (Drèze and Sen 1989: p. 13). Accordingly, the concentration needs to be on human capabilities and complementary "commodities that have a substantial impact on nutrition and health" (Drèze and Sen 1989: p. 13) because different individuals may convert the same quantities of food in different nutritional outcomes due to different combinations of conversion factors (Aurino 2013). The nutritional capability of individuals depends amongst others on conversion factors on the micro level such as age, gender, pregnancy, metabolic rates and general health; and complementary factors on the macro level such as their access to drinking water, sanitation facilities, health care, medical facilities, epidemiological protection, climate conditions, (formal and informal) elementary education (Drèze and Sen 1989; Aurino 2013), storage and processing facilities (Aurino 2013; The Economist Intelligence Unit 2015). Thereby, women have been identified to play a crucial role in ensuring nutritional outcomes not only by their function as a care taker but also by their physical state. For example, anaemia amongst pregnant women can not only lead to higher maternal mortality risks, it can also have a consequence on the newborns nutritional outcome in the longer term (Bhutta et al. 2008; Pangaribowo et al. 2013). With regards to the right to food, the CESCR further clarifies that the available and accessible food needs to be culturally and socially acceptable. Additionally, the quality of diet should be adequate to "satisfy the dietary needs of individuals, free from adverse substances" (General Comment No. 12: para. 8).

The capability approach, the underlying theory of the utilization concept, is very much in line with the human rights approach to focus on the most marginalised and disadvantaged individuals in society (see, e.g., cross-cutting human rights principle of non-discrimination in Article 2 of the ICESCR). The analysis of conversion factors and the achievement of food security at the micro level, shifts the focus to the individual and in particular to a group of

individuals who are disadvantaged by socio-economic or geographic factors, or are more vulnerable due to their conversion factors (e.g. children, elderly, women) (Aurino 2013). The focus on individuals food security outcomes, can provide some further insight into the intra-household distribution of resources (Sen 1985; Devereux 2001; Haddad and Kanbur 1990; Pitt 1990).

The fourth pillar, stability and sustainability, is the requirement that the three pillars, availability, access and utilisation, are stable and also sustainable over time. In other words the fourth pillar incorporates the notion of long-term availability, permanency of access/accessibility (General Comment No. 12: para. 7) and some aspects of utilization (Frankenberger 1992; Barrett 2010; Burchi and De Muro 2012; Aurino 2013).

Conclusively, the first three concepts are hierarchically interdependent. Availability is conditional but not sufficient to ensure access. Access, in turn, is conditional but not sufficient for utilization (Barrett 2010). The fourth pillar adds the time dimension to the hierarchical interdependent three pillars. The complexity of the concept illustrates the challenges not only of defining food security but also of operationalising the measurement of food security (Jones et al. 2013).

2.2.2 Indicators and Three Conceptual Levels

One way of operationalising the measurement of the complex food security concept is to make use of indicators. A food (in-)security indicator depicts a quantitative or a qualitative variable which measures a simplified version of one or some aspect of food (in-)security. The indicator is ideally measured over time and across countries allowing for comparison to reflect changes (Davis et al. 2012; OECD and DAC 2011). Besides food insecurity indicators, right to food indicators, directly identified as such or entailing rights related aspects, will be

introduced in the forthcoming subsection, and therefore also briefly described. Generally, a human rights indicator is defined as capturing a "specific information on the state or condition of an object, event, activity or outcome that can be related to human rights norms and standards; that addresses and reflects human rights principles and concerns; and that can be used to assess and monitor the promotion and implementation of human rights" (OHCHR 2012: p. 16).

Indicators can be distinguished by conceptual levels depending on which spectrum of the process these indicate. The commonly referred to conceptual levels are input, process (activities), output (of these activities), outcome and impact. Input indicators refer to resources allocated to processes within a larger project. Process indicators can be activities, designed to meet a project's objectives, with which the allocated resources are transformed into immediate tangible or non-tangible results, the output indicators. Process and output indicators describe the dynamics that lead to the outcome, which is closely linked to the final aims of the project and quantified by outcome indicators. Impact indicators depict the longer-term effects or higher-level goals to which the project aims to contribute to.

In the context of food security, Aurino (2014) differentiates between 1) input indicators and country structural conditions (indicators for in-depth country assessment), 2) output indicators of underlying determinants of country food security (indicators for action and modelling) and 3) outcome indicators (core food security indicators for global monitoring). Lintelo et al. (2014) identify indicators which reflect a government's commitment to reduce food insecurity to keep these separate from outcomes, which, according to the authors, cannot be controlled by governments. In this Chapter the original terminology of structural, process and output, and outcome variables is kept. Structural indicators are further distinguished into on the one hand legal framework, policy and programme, and on the other hand 'other

underlying structural conditions'. Additionally, the idea of commitment indicators by Lintelo et al. (2014) is integrated in the framework. All in all, the three levels are, similar to the pillars, vertically interdependent. The structural indicators, condition the process indicators, and the latter have an influence on the outcome indicators.

In the literature, an array of food (in-)security indicators is suggested and applied. These metrics may focus on one particular combination of pillar and level (dimension), or operationalise concepts across dimensions (Jones et al. 2013).

2.2.3 Review of Food Security Indicators

Authors across disciplines have conducted reviews of food (in-)security indicators (see, e.g., de Haen et al. 2001, Svedberg 2011, Masset 2011, Aurino 2013, Jones et al. 2013, Pangaribowo et al. 2013). After introducing a varying set of food (in-)security indicators and often critiquing these, the authors compare the chosen indicators either merely descriptively or also quantitatively via correlation analysis or comparative rankings of countries. This review is distinct from the aforementioned examples, as it, rather than describing the indicators substantively only, focuses on the underlying methodology of the measurement. Further, the indicators are comparatively reviewed in light of the introduced pillars and levels, and the potential applicability for statistical analysis. A critique of these indicators is beyond the scope of this Chapter and is already well discussed in amongst others the here listed reviews (de Haen et al. 2001; Svedberg 2011; Masset 2011; Aurino 2013; Jones et al. 2013; Pangaribowo et al. 2013).

Anthropometric indicators: The most obvious indicators for indicating food insecurity are

anthropometric indicators such as stunting (height-for-age), underweight (weight-for-age), and wasting (weight-for-height) (see also examples of undernourishment in subsection 'Theoretical Foundations and Four Pillars'). Stunting is an indicator of the failure to reach the growth potential and therefore it is often seen as an indicator for chronic hunger (Masset 2011). Some argue that the stunting indicator also reflects micronutrient deficiency (Walker et al. 2007). Underweight can be due to long term failure to grow but also due to short term weight loss and is, hence, not easily interpretable. Wasting is the consequence of acute starvation or disease, and portrays rather short term effects (Masset 2001).

These indicators are derived by comparing children under five years old (0-59 months) with a reference population which is estimated by the World Health Organization (WHO) and last reported in 2006 for children from different ethnicities and by gender (WHO Growth Reference Study Group 2006; Alkire et al. 2015). If children are below minus two standard deviations from median height-for-age, weight-for-age, or weight-for-height, of the reference population, then they are counted as stunted, underweight or wasted, respectively.

Country-level data is from national surveys and harmonised by The United Nations Children's Rights and Emergency Relief Organization (UNICEF), WHO and World Bank (WB) (in their harmonized global database on child growth and malnutrition), to make cross-country comparison more feasible. It can be interpreted that anthropometric measures reflect not only food intake conditioned by physical micro factors such as age and gender but also complementary factors on the macro level such as, amongst others, access to sanitation and health services (UNICEF 1990; Jones et al. 2013). Conclusively, anthropometric measures make good utilization outcome indicators.

Biochemical indicators: Indicators which directly measure micronutrient deficiencies are biochemical indicators (also named biomarkers). Biochemical indicators indicating the concentration of amongst others iron, vitamin A and iodine deficiency, across countries are

compiled by the WHO's Vitamin and Mineral Nutrition Information System (VMNIS)[5]. Yet, compiled data is not all comparable across countries and lack of data coverage is an issue. The indicator anaemia,[6] which provides some indication on iron, vitamin A, folate vitamin B12 deficiency amongst others might be the best indicator listed in terms of comparability across countries and data availability; and is therefore focused on. The indicators anaemia among children and anaemia among pregnant women measure the percentage of children under age five (6-59 months) and pregnant women (15-49 years), respectively, having anaemia. Anaemia is characterised by haemoglobin levels below 110 grams per litre at sea level, which are based on haemoglobin distributions estimated via a Bayesian hierarchical mixture model by the Nutrition Impact Model Study Group (Anaemia) (Stevens et al. 2013). Sources of input data are national health, nutrition and household surveys, plus summary statistics amongst others from the WHO's VMNIS. Conclusively, similar to anthropometric indicators, biochemical indicators make great outcome utilization indicators.

Mortality rate: Another food insecurity indicator, referred to in the literature, is the mortality rate amongst children which describes the probability per 1,000 that a newborn dies before reaching year five (0-4 years). It is listed as one of the potential outcome indicators for the right to food within the human rights indicator framework of the Office of the United Nations High Commissioner of Human Rights (2012), and is also included in the Global Hunger Index described further below. Additionally, given the high correlation with anthropometric and biochemical indicators, mortality rates are included in the review. Estimates are generated with a Bayesian B-spline bias-reduction model (Alkema and New 2014) by the United Nations Inter-Agency Group for Child Mortality Estimation with nationally representative data sourced from vital registration systems, populations censuses, household surveys, and sample registration systems (You et al. 2015). Similar to the indicators above, mortality rates

[5]For a complete list of VMNIS indicators see online: http://www.who.int/vmnis/indicators/en/.
[6]Anaemia is a condition in which the number of red blood cells is insufficient (WHO 2011).

reflect besides individual outcomes complementary factors on the macro level. Furthermore, child mortality rates possibly indicate fatal consequences of food insecurity and capture thereby, if so, long-term outcomes under the utilization pillar.

Prevalence of undernourishment: The prevalence of undernourishment (or food inadequacy), "expressed as the share of people in a national population not meeting their minimum food energy requirements" (de Haen et al. 2011: p. 761) is measured by the FAO. The methodology for estimating the prevalence of undernourishment (or food inadequacy) is based on the comparison of a probability distribution of the annual average of daily habitual dietary energy intake of a representative (average) individual in the reference population and a threshold level, called the minimum dietary energy requirement (MDER) for an active and healthy life based on a physical activity level of 1.55 (prevalence of undernourishment) or for an even higher physical activity level of 1.75 (prevalence of food inadequacy) (FAO 2013; Moltedo et al. 2014).

The FAO estimates dietary energy consumption per capita in a country by calculating per capita dietary energy supply based on FAO's food balance sheets. Per capita dietary energy supply is derived from data on production, trade, food stock changes, non-food uses and food waste and losses (FAO 2013). Access to the calories is estimated by assuming a probability distribution of habitual energy consumption (adoption of the skew-normal and skew-lognormal families of distributions introduced by Azzalini) defined by the mean dietary energy supply and the coefficient of variation. The coefficient of variation is based on sample distributions of calorie consumption or food expenditures from available representative national household surveys (FAO 2013; de Haen et al. 2011). To calculate the MDER threshold, FAO employs a normative energy requirement standards based on the result of the joint FAO, WHO and UNU consultation of 2001 (FAO 2001; FAO 2013).

To summarize, the 'prevalence of undernourishment' indicator is estimated based on the

quantity of calories available, the access to those calories among the population, and the mean minimum amount of calories required by the population (de Haen et al. 2011: p. 761). Therefore, in a strict sense, this indicator, even though it can represent substantively the concept of an access or utilization outcome indicator, is technically an indicator combining the availability and utilization pillar on the outcome level. FAO categorizes its measure as an access indicator. Here, for the purposes of further analysis, prevalence of undernourishment is based on its substantive interpretation categorized as an utilization outcome indicator.

SERF Right to Food Index: The SERF Right to Food Index by the Economic and Social Rights Empowerment Initiative is calculated based on two variables: stunting of children (for non-OECD countries) below five years and per capita GDP (PPP constant 2005 international dollars). The latter functions as the proxy for resource capacity to reflect the economic and social human rights concept of maximum available resources (see subsection 'Theoretical Foundations and Four Pillars'). GDP per capita is plotted against the stunting variables across non-OECD countries and time (1990-2006), resulting in a scatter plott. An achievement possibilities frontier (APF) is then fitted through the outer envelope of the scatter plot, indicating the benchmark level of obligation at any given GDP per capita. A rescaled performance indicator is calculated for each country and then compared with the relevant APF benchmark level. The difference reveals the percentage of feasible level of the right to food enjoyment achieved (Fukuda-Parr et al. 2011; Fukueda et al. 2015; see also Landman and Kersten 2016). Whilst this indicator technically combines the access and utilization pillar, it is here categorized as an utilization outcome indicator adding in a human rights element by capturing the progressive realisation of the right to food.

Global Hunger Index: The Global Hunger Index, published by the International Food Policy Research Institute (IFPRI) since 2006, is the arithmetic mean of three equally weighted

components: the proportion of the population that is undernourished (FAO's prevalence of undernourishment to indicate insufficient calorie intake), the prevalence of underweight in children younger than five (as an indicator of child undernutrition) and the proportion of children dying before the age of five (synergy of inadequate dietary intake and unhealthy environments). The index varies between a minimum of 0 (no hunger) and a maximum of 100 (complete hunger). The intention of the index is to address the multidimensionality of food insecurity and is used to rank 121 countries (Masset 2011). This composite index aggregates three of the outcome utilization indicators. Whilst the weighting scheme is simple it is also rather arbitrary (Masset 2011). Furthermore, only few data points in time (every five years from 1990) are provided. Therefore, the three components in its initial disaggregated form are of interest for the further analysis.

Global Food Security Index: The Global Food Security Index, issued by the Economist Intelligence Unit (EIU) since 2012, attempts to rank 109 countries according to their vulnerability to food insecurity. The index is constructed based on 28 indicators categorised under the three pillars affordability, availability, and quality and safety. Based on the variables, the affordability pillar is most similar to the access pillar, the availability pillar to the availability pillar, the quality and safety pillar to the utilization pillar.

The six indicators under the affordability pillar are: 1) food consumption as a share of household expenditure; 2) proportion of population under the global poverty line; 3) gross domestic product per capita (PPP); 4) agricultural import tariffs; 5) presence of food safety-net programmes; 6) access to financing for farmers.

The eleven indicators under the supply pillar are: sufficiency of supply consisting of 7) average food supply and 8) dependency on chronic food aid; 9) public expenditure on agri-

cultural research and development; agricultural infrastructure consisting of 10) existence of adequate crop storage facilities, 11) road infrastructure, 12) port infrastructure; 13) volatility of agricultural production; 14) political stability risk, 15) corruption; 16) urban absorption capacity; and 17) food.

The eleven indicators under the quality and safety pillar are: 18) diet diversification; nutritional standards consisting of 19) national dietary guidelines, 20) national nutrition plan or strategy, 21) nutrition monitoring and surveillance; micronutrient availability consisting of 22) dietary availability of vitamin A, 23) dietary availability of animal iron and 24) dietary availability of vegetal iron; 25) protein quality; food safety consisting of 26) agency to ensure the safety and health of food, 27) percentage of population with access to potable water and 28) presence of formal grocery sector.

The pillar scores are first calculated from the weighted (equal or based on panel recommendation) mean of the underlying normalised indicators and scaled from 0 to 100. Then, the overall score is calculated via the simple weighted average of the category scores (The Economist Intelligence Unit 2015).

Data is drawn from multiple sources - mainly from the FAO, WHO, WB, and internal sources such as EIU risk briefings and EIU's calculations and qualitative scoring. The composite index aggregates all three pillars and different indicator levels into one measure. The highly composite nature and data availability since 2012 only, render the index unusable for the envisaged purposes of further analysis in this Chapter.

Hunger and Nutrition Commitment Index: The Hunger and Nutrition Commitment Index is developed by te Lintelo et al. (2013, 2014), to measure a government's commitment to re-

duce hunger. The index available from 2012 is constructed on the basis of performance in the thematic areas of policy and programmes, legal framework and public expenditure. These three areas are categorised according to a combination of one of the three pillars (food availability, access and utilisation) and one of four sectors such as food and agriculture, women's empowerment, social protection and health environment (te Lintelo et al. 2014; Pangaribowo et al. 2013).

In total nine indicators are identified and categorised as follows: 1) public expenditures on agriculture (availability - food and agriculture), 2) public expenditure on education (access - women's empowerment), 3) public expenditures on health (utilisation - health environment), 4) access to improved sanitation (utilisation - health environment), 5) women's access to agricultural land (availability - women's empowerment), 6) civil registration of births (access - health environment), 7) constitutional right to social security (access - social protection), 8) constitutional protection of right to food (access - social protection), 9) existence of a national hunger or nutrition strategy (all categories).

The single indicators are normalised, weighted and aggregated into subsets for each area (policy and programmes, legal framework and public expenditure). The 21 analysed countries are then ranked according to the subset indices. An overall ranking is achieved by ranking the countries according to the sum of the subset indices for each country (Borda ranking scheme to preserve the ordinal nature of the index) (te Lintelo et al. 2014).
The intention behind this index is to keep commitment separate from outcome (Pangaribowo et al. 2013) based on the notion that governments contribute to but do not have total control over outcomes. According to the authors more insight might be "generated into commitment if commitment is set against levels and progress in outcomes" (te Lintelo et al. 2014: p. 116). Whilst this composite index is in comparison with the previous composite

index more distinct in terms of levels (commitment), it has a similar low data coverage in terms of points in time, and an even lower in terms of countries; and is therefore unfit for the purposes here.

Generally, the aggregation of indicators into composite indices is two-sided: on the one hand these indices capture some of the multidimensionality of food (in-)security, but on the other hand it is the aggregation, often across dimensions of pillars and levels, that can render the understanding of food (in-)security even fuzzier. This in particular is the case if the aggregation function is not founded in a clear underlying theory of the concept and/or is rather arbitrary. Therefore out of these reasons besides data coverage, only the SERF and FAO index, which can be categorized into one dimension, are taken on besides the single indicators. However, the review has highlighted that the single indicators are in most cases estimates and have to be therefore understood in the context of its data gathering and generating process. To guide a meaningful identification and concrete selection of food (in-)security indicators, a theory driven conceptual framework is developed.

2.3 SYNTHESIS, CONCEPTUAL FRAMEWORK AND RESEARCH DESIGN

Similar to the indicators, varying food (in-)security or right to food frameworks have been suggested in the literature (see in particular Aurino 2014 and OHCHR 2012; see also te Lintelo et al. 2014, EIU 2015, and to some degree Panagaribowo et al. 2013). Yet, all these frameworks lack to provide a comprehensive and at the same time compact overview of the food (in-)security concept. The conceptual framework introduced here, see Figure 2.3.1, fills this gap by synthesising information on theory, theory driven pillars and indicator levels, further information on aggregation levels and conversion factors. This framework facilitates the identification of potential variables; and a number of concrete indicators including their source (author and/or data compiler) are listed in Figure 2.3.1 as suggestions.

In detail, the framework combines the three pillars (Availability, Access and Utilization) with the three levels (Structural, Process and Outcome) into nine dimensions. Additionally, potential commitment indicators as suggested by Lintelo et al. (2014) are indicated across the dimensions (with preceding letter 'c'). As the introduction of the different pillars already indicated, indicators can be measured on different levels of aggregation: macro, meso and micro levels. In theory food availability is a concept mainly on the macro to meso level (country, region, community), access/accessibility on the macro (country) to micro (household) level, and utilization/acceptability/adequacy mainly on the micro level (household and individual) (Aurino 2013). Access/accessibility does not only depend on availability but can also depend on a set of macro conversion factors (which condition and contextualise access) such as market structure including transparency, public goods and services and political freedoms.[7] One proxy for the macro conversion factors is the political stability variable - calculated by Brookings Institution and WB agenices, and compiled by FAO and WB.

[7] See also Sen (1999) on instrumental freedoms: political freedoms, economic facilities, social opportunities, transparency guarantees, protective security (Aurino 2013).

Once access is given, utilization depends on micro conversion factors such as age, gender, metabolism, pregnancy and health (as previously outlined) which convert accessed and then consumed food into individual nutritional outcomes (Drèze and Sen 1989; Aurino 2013). Some of the indicators on the utilization outcome dimension, e.g., anaemia amongst pregnant women, have some of these micro conversion factors incorporated by definition and/or construction. In light of the micro conversion factors, food security and the right to food are in principle individual concepts. Disaggregation ideally allows an analysis of the variability of outcomes distributed within and between socio-economic groups (Devereux 2001; Haddad and Kanbur 1990; Pitt et al. 1990).

The selection of variables within each dimension is primarily based on the underlying combined theory of each pillar and indicator level, and secondly on their availability - the latter indicated by the relevant source (author or compiler such as the Food and Agriculture Organization of the United Nations (FAO), the World Bank (WB), Agricultural Science and Technology Indicators led by International Food Policy Research Institute (ASTI led by IFPRI), International Trade Centre (ITC), The United Nations Children's Rights and Emergency Relief Organization (UNICEF), and the World Health Organisation (WHO)). Indicators in braces might be available from national or regional databases[8] but are not yet harmonized and compiled in a cross-country database. Therefore, these remain at this stage indicators to be wished for and are listed here for a higher degree of completeness. The fourth pillar stability or sustainability adds a time dimension across all nine dimensions, implying that variables should be ideally presented over time to highlight their changes and/or degree of variability.

Structural indicators with regard to the legal framework, policy and programme across the first three pillars can be dummy or categorical variables. These can indicate the underlying

[8] For an overview see, e.g., Jones et al. 2013.

law and/or governance structure with regard to the right to food (all three pillars), the agricultural sector, food availability (first pillar), land law and customs in terms of access to land, and welfare and inclusion policies (second pillar) and food quality (third pillar).

Underlying structural conditions for food availability are as well as the general economical condition of a country, land availability for agriculture, the quality of soil and water, and the climate. Process indicators can be the investment in the agricultural sector plus the performance of the sector. The outcome indicator under the availability variables is ideally the net supply or per capita availability of major food items. Proxies for this indicator are variables indicating the entire food production (value of food production, food production index), dietary energy supply adequacy, food waste, the affordability of food imports (value of food imports over total merchandise exports), and food import (cereals) and aid dependency. Additionally, the variable food stocks might provide further indication on food availability.

Structural and process indicators under the 'access to food' pillar can be divided, in line with the theory outlined in subsection 'Theoretical Foundations and Four Pillars', into three categories: economic, social and physical. Economic structural condition indicators ideally describe the overall situation for food affordability. Variables on the national level are domestic income per capita, long-term unemployment rates, food prices, inflation and exchange rates, and possibly import tariff rates. Ideal social indicators are variables on social protection and inclusion policies (see also under law, policy, program). The geography of a country, but also the build-up infrastructure for the agricultural and food sector are conditional factors for accessibility to food.

On the process level, economic indicators are variables describing households' food affordability such as capital and work income or the disposable income, food consumption and

expenditure disaggregated by population groups. Concrete social indicators are ideally work participation (or unemployment) rates by sector and effectively received social benefits. Physical process indicators are variables such as road density, paved roads over total roads and rail-lines density. For better information on physical access to food, indicators on food deserts or, alternatively (the opposite), access to farmer markets and food stores with fresh vegetables and fruits, are ideal.

A proxy for access outcome indicators are apart from being the concrete variable of food expenditure of the poor, variables measuring income but also rural-urban inequality, such as the GINI coefficient, poverty gap or headcount ratio at 1.90 or 3.10 dollars, or the rural poverty gap or headcount ratio at national poverty lines. The rural population, whose income relies often significantly on agriculture, belongs in particular in low and mid income countries to the most food insecure. Thereafter, rural population change can function as a proxy for access outcome indicators.

Structural indicators under the utilization pillar are complementary factors at the macro level such as the general availability of and access to drinking water, sanitation facilities, health care, medical facilities, epidemiological protection, climate conditions, (formal and informal) and elementary education as mentioned in subsection 'Theoretical Foundations and Four Pillars'. Ideal proxies for these are indicators on the coverage of drinking water, sanitation, medical, processing and storage facilities and educational institutions. Available variables are health expenditure per capita of GDP, diarrhoea treatment and immunization for children, enrolment rate for primary education and literacy rate.

Process indicators providing a proxy for the concrete access to these facilities are improved access to water and sanitation, and electricity (proxy for processing and storage facilities).

Further process variables for the utilization pillar in terms of dietary adequacy are consumption of iodized salt and coverage rate of vitamin A supplements among children (ideally, nutritional intake based on the general daily diet should be accounted for). Further variables describing dietary adequacy, proxy indicators on cultural (and social), and medical adequacy would be ideal.

Finally, outcome indicators under the utilization pillar, are variables describing the outcome of poor physical absorption and/or use of nutrients (see also subsection 'Theoretical Foundations and Four Pillars'). These are anthropometric indicators such as stunting, underweight and wasting among children and biomedical indicators such as anaemia among children and pregnant women, vitamin A and iodine deficiency. Moreover, variables prevalence of undernourishment (or food inadequacy) and the right to food index are, for the purpose of the Chapter, categorised as outcome utilization indicators.

Given the hierarchical structure of the first three pillars and the vertical structure of the three levels, the utilization outcome indicators have a pivotal function and can be interpreted as the variables measuring the actual realisation of food (in-)security. Accordingly, the framework suggests to test the following. I) Outcome utilization indicators - covering multifaceted aspects of short and longterm effects of insufficient and inadequate food intake amongst children and pregnant women (taking into account some of the micro conversion factors), plus the progressive realisation of the right to food - compose a latent variable of food insecurity. II) Given the multidimensional interdependent structures the suggested indicators of the remaining dimensions contribute to the explanation of the just defined latent variable food insecurity.

Figure 2.3.1: Conceptual Framework

Level	Macro/Meso: country, region, community	⟷	Macro/Micro: country, households	⟷	Micro: individuals
Pillar	**Availability**		**Access/Accessibility**		**Utilization/Acceptability/Adequacy**
Theory	Supply≥Demand	Macro Conversion Factors	Entitlement	Micro Conversion Factors	Capability
Structural I legal framework, policy, programme,	- c: international human rights treaties relevant to the right to adequate food ratified by the state - c: coverage and implementation of the right to adequate food in the constitution or other forms of superior law				
	- c: national policy or programme on: agricultural production and food availability; drought, crop failure and disaster management - international trade agreements		- c: land law incl. women's access to land - c: social protection and inclusion policies		- c: national policy or programme on: food safety, consumer protection, nutrition
Structural II other structural conditions	- GDP per capita (growth) [WB] - agricultural land [WB] - agricultural irrigated land [WB] ◦ {climate, soil and water quality}	market structure incl. transparency, public goods and services, political freedoms (political stability [FAO])	- economic: GDP per capita (growth) [WB], long-term unemployment [WB], domestic food price index [FAO], inflation rate of consumer prices [WB], real effective exchange rate [WB], applied import tariff rate [ITC] - social: {c: social protection and inclusion} - physical: {geography, agricultural/food infrastructure}	age, gender, metabolism, pregnancy, health	- c: health expenditure per capita or of GDP [WB], diarrhoea treatment for children [WB], immunization children DPT, measles [WB], immunization newborns tetanus [WB] - c: expenditure on education [WB] - enrolment rate primary education [WB], literacy rate [WB] ◦ {climate, coverage of drinking water, sanitation, medical, processing and storage facilities}
Process and Output	- c: expenditure on agricultural research and development [ASTI] - GDP value added of agricultural sector [WB] ◦ {quality and net value output on farm level}		- economic: {households' capital and work income, disposable income, food consumption and expenditure by population groups} - social: {work participation rates by sector, social benefits} - physical: road density [WB], paved roads over total roads [WB], rail-lines density [WB], {food deserts, access to markets and stores}		- access to improved water source [WB] - access to improved sanitation facilities [WB] - access to electricity [WB] - consumption of iodized salt [WB] - vitamin A supplementation coverage rate among children [WB] ◦ {indicators on whether supplied food is culturally, medically and dietary adequate}
Outcome	- value of food production [FAO] - food production index [WB] - dietary energy supply adequacy [FAO] - food waste [FAO] - value of food imports over total merchandise exports [FAO] - cereal import dependency ratio [FAO] - (dependency on chronic food) aid [WFP] - food stocks [FAO] ◦ {per capita availability of major food items}		- GINI index [WB] - poverty gap or headcount ratio at $1.90 or $3.10 a day [WB] - share of food expenditure of the poor [FAO] - rural poverty gap or headcount ratio at national poverty lines [WB] - rural population growth [WB]		- stunting, underweight, wasting among children [UNICEF, WHO, WB] - anaemia among children [WB] - anaemia among pregnant women [WB] - mortality among children [WB] - prevalence of undernourishment [FAO] - prevalence of food inadequacy [FAO] - realisation of the right to food [SERF] ◦ {prevalence of iodine deficiency [FAO]} ◦ {prevalence of vitamin A deficiency among children [FAO]}
	Stability/Sustainability variables above over time (incl. variables on variability)				

Note: c - indicates government's commitment.

Source: Own adaption of WFP (2009), Aurino (2014), Burchi and De Muro (2012), EIU (2015), Jones et al. (2013), OHCHR (2012), Black et al. (2008), te Lintelo et al. (2014); Panagaribowo et al. (2013) following Adcock and Collier (2001), see also Landman and Carvalho (2010).

2.4 MEASURING FOOD INSECURITY

2.4.1 DATA AND DESCRIPTIVE STATISTICS

I begin with presenting following outcome variables under the utilization pillar as listed in Table 2.4.1 to evaluate whether these are potentially appropriate for operalitionising these into a latent variable food insecurity, *foodinsec*.

Table 2.4.1: List of Utilization Outcome Variables

Variable	Description (incl. unit)	Source
mortality	children under 5 yr. mortality rate (inf. per 1000 live births)	WB
stunting	children under 5 yr. below -2 st.dev. from median height-for-age (percentage)	H
underweight	children under 5 yr. below -2 st.dev. from median weight-for-age (percentage)	H
wasting	children under 5 yr. below -2 st.dev. from median weight-for-height (percentage)	H
anaemia	prevalence of anaemia among children (percentage)	WB
anaempreg	prevalence of anaemia among pregnant women (percentage)	WB
undnourish	prevalence of undernourishment in population (percentage)	FAO
rightfood	progressive fulfilment of the righ to food (index)	SERF

Descriptive statistics for these eight variables are presented in Table 2.4.1 for 114 low and mid-income countries (see Annex for list of countries) in 2010 (the most recent year for which data are available for all eight variables).

Table 2.4.2: Descriptive Statistics for Utilization Outcome Variables (t=2010)

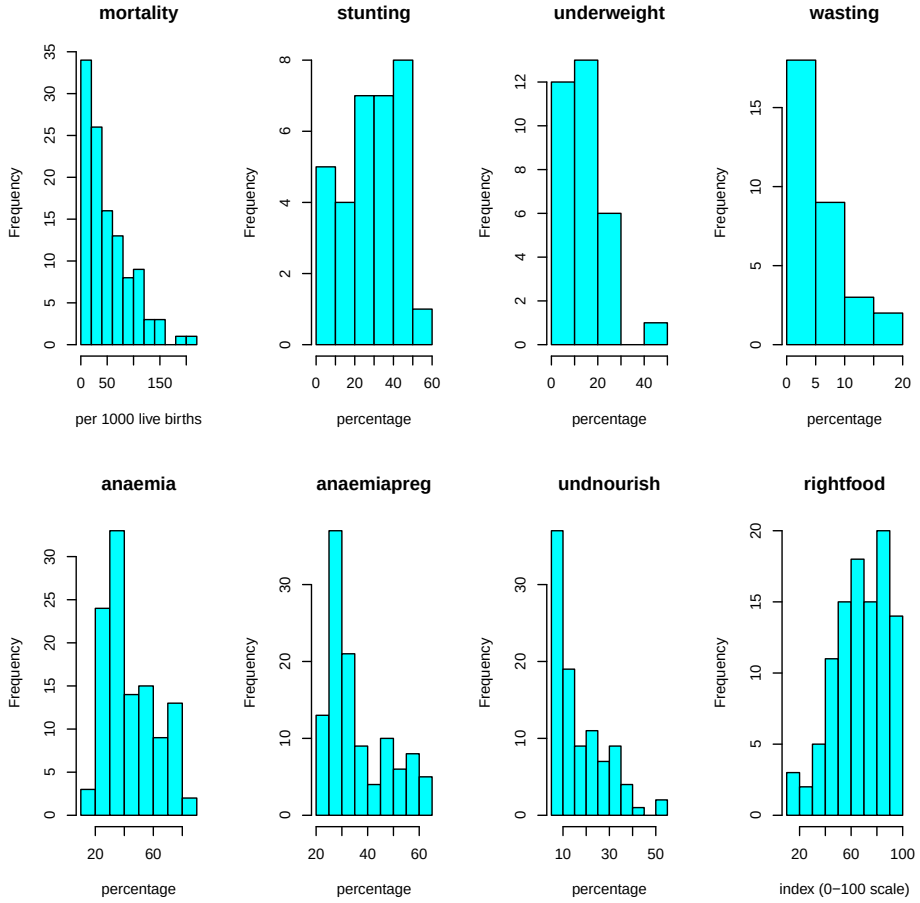
Variable	Mean	St. Dev.	Min.	Max.	Skewness	Kurtosis	Obs. (Missings)
mortality	51.509	42.155	6	209	1.329	4.506	114 (0)
stunting	29.125	14.248	5	58	-0.155	2.001	32 (82)
underweight	14.469	10.327	2	45	0.806	3.518	32 (82)
wasting	6.406	4.564	1	19	1.050	3.477	32 (82)
anaemia	44.637	17.422	17	87	0.589	2.166	113 (1)
anaempreg	36.257	12.017	20	65	0.883	2.500	113 (1)
undnourish[1]	16.818	11.609	5	53	0.963	3.292	99 (14)
rightfood	68.165	20.642	13	100	-0.492	2.802	103 (11)

Note: [1]For values indicated < 5 the value 5 was inserted. Consequently relevant statistics might be overstated.

The descriptive statistics provide some indication that the indicators are not normally dis-

tributed. Histograms in Figure 2.4.1 visualise the distribution of each variable across 114 countries in 2010.

Figure 2.4.1: Histograms of Utilization Outcome Variables (t=2010)



The histograms show that the distributions in the case of *mortality, underweight, wasting, anemiapreg* and *undernourish* are positively skewed. *Rightfood* is negatively distributed. The distribution of the latter, *aneamia* and *stunting* approximate best a normal distribution. To analyse how the variables are related to each other pairwise (Pearson) correlations are shown in Table 2.4.3.

Table 2.4.3: Pairwise Correlation (Pearson) Matrix of Utilization Outcome Variables (t=2010)

	1	2	3	4	5	6	7	8
1 mortality	1.000							
	(114)							
2 stunting	0.619***	1.000						
	(32)	(32)						
3 underweight	0.589***	0.804***	1.000					
	(32)	(32)	(32)					
4 wasting	0.436**	0.534***	0.884***	1.000				
	(32)	(32)	(32)	(32)				
5 anaemia	0.800***	0.574***	0.595***	0.485***	1.000			
	(113)	(32)	(32)	(32)	(113)			
6 anaempreg	0.708***	0.310*	0.414**	0.384**	0.890***	1.000		
	(113)	(32)	(32)	(32)	(113)	(113)		
7 undnourish	0.517***	0.726***	0.576***	0.323*	0.356***	0.174*	1.000	
	(99)	(30)	(30)	(30)	(99)	(99)	(99)	
8 rightfood	-0.355***	-0.719***	-0.552***	-0.385**	-0.337***	-0.216**	-0.398***	1.000
	(103)	(31)	(31)	(31)	(103)	(103)	(92)	(103)

Note: Number of pairwise observations are in parentheses; *p<0.1; **p<0.05; ***p<0.01.

Variables *mortality*, *stunting*, *anaemia* are highly positively correlated amongst and with the other variables except few exceptions. Variable *rightfood* is expectedly negatively correlated with all other variables (by construction and substantively as the right to food might be less realised if child mortality, stunting, etc. is high). Variables which are strongly correlated (ρ>0.80) with another variable that substantively covers some aspects of the first,[9]are not taken on to avoid too much content overlap. Accordingly, *underweight* to avoid too much content overlap with *stunting*, and *wasting*; and *anaemia* as it is well reflected via *mortality* and *anaemiapreg* are not included in further analysis. Whilst it can be argued that the reduced set of the six remaining variables still entails highly pairwise correlation amongst, these do cover substantially various aspects of food insecurity on the utilization outcome dimension. Accordingly, in line with the first test variables *mortality*, *stunting*, *wasting*, *anaemiapreg*, *undernourish* and *rightfood* are selected to measure the latent concept *foodinsec*.

[9]High correlation might not suggest interchangeability as Caspers and Tufis (2003) have shown in the context of democracy measures.

Other than the utilization outcome indicators, the conceptual framework suggests further variables. These are screened and selected in terms of data availability (114 observations) and variability. Eight potential covariates are accordingly identified as listed in Table 2.4.4.

Table 2.4.4: List of Covariates

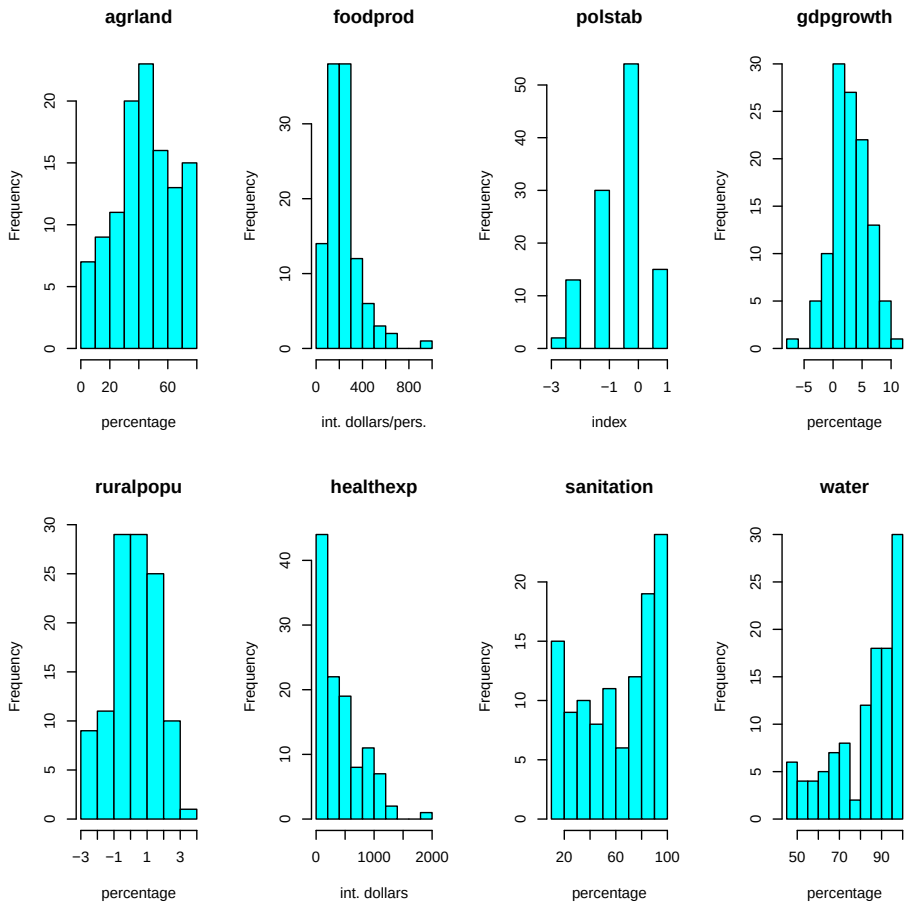
Variable	Description (incl. unit)	Source
agrland	agricultural land (percentage of total land area)	WB
foodprod	(3-year) average value of food production (international dollar per person)	FAO
polstab	political stability and absence of violence (index)	FAO
gdpgrowth	GDP per capita annual growth (percentage)	WB
ruralpopu	rural population annual growth (percentage)	WB
healthexp	health expenditure per capita (PPP constant 2011 international dollar)	WB
sanitation	population access to sanitation (percentage)	WB
water	population access to water (percentage)	WB

Five dimensions plus one macro conversion factor, are represented by the selection of variables: the availability structural dimension by *agrland*, the availability outcome dimension by *foodprod*, the access structural dimension by *gdpgrowth*, the access outcome dimension by *ruralpopu*, the utilization process dimension by *healthexp*, *sanitation* and *water*, and the macro conversion factor by *polstab*. Corresponding descriptive statistics of the eight variables are presented in Table 2.4.5 and relevant histograms are illustrated in Figure 2.4.2.

Table 2.4.5: Descriptive Statistics for Covariates (t=2010)

Variable	Mean	St. Dev.	Min.	Max.	Skewness	Kurtosis	Obs. (Missings)
agrland	44.211	19.760	1	80	-0.155	2.226	114 (0)
foodprod	237.368	138.284	29	964	1.942	9.275	114 (0)
polstab	-0.412	0.920	-3	1	-0.534	2.956	114 (0)
gdpgrowth	3.500	3.135	-7	12	-0.068	3.590	114 (0)
ruralpopu	0.711	1.456	-3	4	-0.370	2.894	114 (0)
healthexp	423.281	363.122	34	1823	1.174	3.981	114 (0)
sanitation	60.930	28.658	10	100	-0.333	1.695	114 (0)
water	83.070	15.142	47	100	-0.918	2.690	114 (0)

Figure 2.4.2: Histograms of Covariates (t=2010)



I apply a two-stage Structural Equations Approach, which is formally introduced in the following.

2.4.2 STRUCTURAL EQUATIONS APPROACH

Structural equation modelling is a statistical method that can take on a confirmatory approach and is therefore ideal to test the theory driven suggestion of the horizontally and vertically integrated latent measure 'food insecurity'. Confirmatory Factor Analysis (CFA) and Multiple Indicators and Multiple Causes Model (MIMIC) are forms of structural equation modelling.[10] In a first step, I apply CFA to test the suggested latent concept of food insecurity. The idea is to test whether the identified utilization outcome indicators constitute the latent concept food insecurity. In a second step, I test whether the proposed pivotal function (interdependent structures of the pillars and levels) of the latent concept food insecurity defined via outcome utilization indicators holds. To do so I specify a MIMIC which tests whether the suggested covariates contribute to the explanation of the latent variable food insecurity - or more generally whether a model can be modelled as such. The MIMIC model, introduced by Jöreskog and Goldberger (1975), integrates a measurement part (measuring latent variable), and a structural part (regressing latent variable on covariates). The formal applied model(s) are specified as follows.

The CFA, which also constitutes the measurement part of the MIMIC model is

$$\mathbf{y} = \boldsymbol{\lambda} z + \boldsymbol{\epsilon} \tag{2.4.1}$$

where $\mathbf{y}$ is a $kx1$ vector of observable items ('outcome utilization' variables), z is the scalar of the latent concept 'food insecurity', $\boldsymbol{\lambda}$ is a $kx1$ vector of factor loadings, and $\boldsymbol{\epsilon}$ is a $kx1$ vector of error variances of each item. k denotes the number of observable items (here $k = 1, ..., 6$). Errors ϵ_k are in the basic form mutually independent. This will be partly relaxed as shown in Subsection 4.3. Further, the expected value of squaring the errors, results into a kxk diagonal

[10] See for further elaboration on CFA and MIMIC estimation Annex A.I.

matrix $\boldsymbol{\Theta}$ with standard deviations of the ϵ_k on its diagonal ($E(\boldsymbol{\epsilon}\boldsymbol{\epsilon}' = \boldsymbol{\Theta})$).

The structural part of the MIMIC is defined as follows

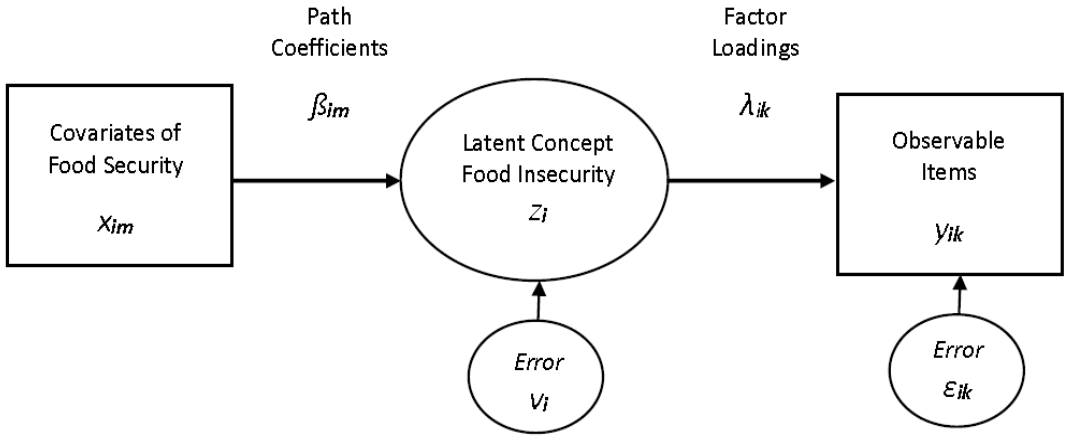
$$z = \boldsymbol{\beta}'\boldsymbol{x} + \upsilon \tag{2.4.2}$$

where z is a scalar of the latent variable 'food insecurity', $\boldsymbol{\beta}$ is a $mx1$ (and inverted $1xm$) vector of path coefficients, $\mathbf{x}$ is a $mx1$ vector of covariates or even exogenous causes of z, and υ is a scalar of random measurement error of the latent concept. m denotes the number of covariates (here $m = 1,...,8$). Errors of the measurement equation ϵ_k and structural equation υ are independent ($E(\upsilon\boldsymbol{\epsilon}') = \mathbf{0}'$), and the variance of the error term of the structural part is constant ($E(\upsilon^2) = \sigma^2$). The MIMIC can be mathematically summarized into

$$\mathbf{y} = \boldsymbol{\lambda}(\boldsymbol{\beta}'\boldsymbol{x} + \upsilon) + \boldsymbol{\epsilon} \tag{2.4.3}$$

and illustrated in a path diagram as shown in Figure 2.4.3 for i countries .

Figure 2.4.3: Path Diagram for Specified MIMIC Model



The parameters (path coefficients, factor loadings, factor variances and covariances, error

variances and covariances) are estimated to produce a predicted/hypothesized variance-covariance matrix $\boldsymbol{\Sigma}$ that resembles the sample variance-covariance matrix $\mathbf{S}$ as closely as possible. Given the highly skewed distributions of the items, the chosen estimation method to minimize the differences between $\boldsymbol{\Sigma}$ and $\mathbf{S}$ is Robust Maximum Likelihood (MLR) with robut standard errors. Further, the application of MLR, in the here employed software M*plus*7, assumes missing data to be missing at random.

2.4.3 RESULTS

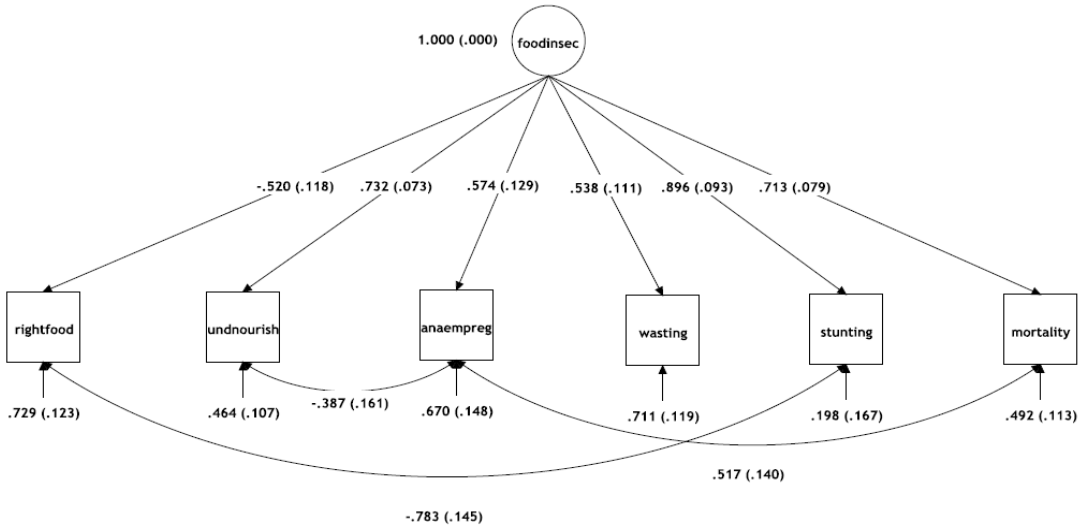
In a first step, I model the CFA with latent variable food insecurity as the factor, *foodinsec*, and six out of the eight observable utilization outcome variables as items - as listed in Table 2.4.1, namely *mortality*, *stunting*, *wasting*, *anaempreg*, *undernourish* and *rightfood*.

The unit of measurement across the eight observable items varies, and therefore estimated parameter results are presented in its standardized values. In a CFA, one of the item or the latent variable itself needs to be selected to be the marker indicator. In the underlying case, the selection does not alter the values of the standardized results (with the exception of *rightfood* in terms of sign flip only, as expected). Here, item *mortality* is selected as the marker indicator.

In line with Modification Indices and substantive reasonableness/meaningfulness, the proposed model includes following pairwise residual correlations of items indicating a variation amongst them due to a further external cause (Brown 2008): *anaempreg* and *mortality* - anaemia amongst pregnant women can result in long-term consequences up to death of children; *undernourish* and *anaempreg* - some item content overlap here; and *stunting* and *rightfood* - the right to food index has stunting amongst children as one of its component,

and consequently the realisation of the right to food and stunting have a covariation that is due to an exogenous factor other than the latent variable *foodinsec*. Completely standardized results for the specified CFA are presented in a path diagram in Figure 2.4.4.

Figure 2.4.4: CFA Path Diagram showing Completely Standardized Results (t=2010, i=114)



Standardized factor loadings are located with standard errors in parentheses on each relevant single-headed arrow originating in the latent concept symbolized with a circle. Factor loadings can be interpreted as the change if food insecurity changes by one standardized score. For example, in the case of *stunting* one standardized score change of *foodinsec* is, ceteris paribus, associated with a 0.90 standardized score increase in *stunting* (Brown 2006). Additionally, in this particular case of no double-loading indicators and one latent factor, the completely standardized factor loading can be interpreted as the correlation of the indicator with the latent factor. Accordingly, the square of completely standardized factor loading for *stunting*, 0.81, is the proportion of variance (in the indicator) that is explained by the latent factor *foodinsec* (Brown 2006). Hence, in the standardized solution, the errors (residual variances), which are reported together with relevant standard errors of these in parentheses

below the items symbolised with a square, indicate the proportion of variance in the relevant item that is not accounted for by the latent concept (e.g., for *stunting* 1-0.81=0.19)); and are therefore also named unique variances.

All factor loadings are statistically significant (z<0.0001) and standardized factor loadings are above 0.40 and can therefore be considered as salient.[11] The direction of effect of all factor loadings is in line with theory: all factor loadings are positive except *rightfood*. The estimates of the modelled pairwise correlations amongst the measurement errors are presented on the double-headed arrows connecting the relevant items. All of these are statistically significant.

The CFA model fits according to the standard fit indices the data very well (see Table 2.4.6 for details). The Null-Hypothesis under the very strict Chi-Square Test (sample variance-covariance matrix is equal to the predicted variance-covariance matrix) can not be rejected, the Root Mean Square Error of Approximation (RMSEA), the Standardized Root Mean Square Residual (SRMR), the Tucker-Lewis Index (TLI) and Comparative Fit Index (CFI) are all far greater than the suggested cut-off criteria and thereby indicate that the model does fit the data very well on their terms. Conclusively, the latent concept food insecurity is statistically (construct validity) and substantially well captured via the utilization outcome indicators and the specified model structure.

[11] This is not the case for non-standardized results. Non-standardized results indicate that in particular *wasting* is not salient.

Table 2.4.6: Fit and Model Selection Indices for CFA and MIMIC (t=2010, i=114)

Abbreviation	Name	Value	
		CFA	MIMIC
χ^2	Chi-Square Test Statistic	7.026 (df=6)	127.163*** (df=46)
RMSEA	Root Mean Square Error of Approximation	0.039	0.124***
CFI	Comparative Fit Index	0.993	0.809
TLI	Tucker-Lewis Index	0.983	0.738
SRMR	Standardized Root Mean Square Residual	0.077	0.072
AIC	Akaike Information Criteria	4024.302	3857.603
BIC	Bayesian Information Criteria	4081.763	3936.953

Note: *p<0.1; **p<0.05; ***p<0.01.

In a second step, I regress the latent concept *foodinsec* as specified above in a MIMIC on most variables as put forward in the theoretic framework in Figure 2.3.1. However, only a limited set of covariates as listed in Table 2.4.4 is selected for final model specifications based on, first, data availability (114 observations) and variability for the year 2010, and second, on statistically[12] and theoretically sound results. The specified MIMIC does not fit the data well in terms of the fit indices with the exception of the SRMR which is below the 0.08 cut-off criterion (see Table 2.4.6 for details). Nevertheless, the estimated coefficients (structural part) and factor loadings (measurement part) provide theoretically reasonable results as presented in Table 2.4.7.

Regarding the measurement part, all factor loadings of the latent variable are salient, significant and generally in line with the CFA values. Regarding the structural part, all coefficients are theoretically reasonable in terms of direction of effect, yet not all covariates contribute to the explanation of the variation of food insecurity across countries in 2010 significantly at the ten percent level. In detail, the less agricultural land, food production, political stability, income growth, (health expenditure as a proxy for) health services , improved access to water

[12]Statistically sound might not necessarily mean that the estimate of the single parameter needs to contribute significantly to the explanation of the latent variable, but it may be dropped if the overall model fit deteriorates if the variable is added in, as e.g. in the case of 'access to electricity'.

Table 2.4.7: MIMIC Standardized Estimates for Measurement and Structural Part (t=2010, i=114)

	Estimate	(Standard Error)
Measurement Part		
mortality	0.819***	(0.035)
stunting	0.842***	(0.034)
wasting	0.512***	(0.096)
anaempreg	0.702***	(0.054)
undnourish	0.620***	(0.068)
rightfood	−0.532***	(0.080)
anaempreg c mortality	0.339***	(0.087)
undnourish c anaempreg	−0.417***	(0.085)
stunting c rightfood	−0.738***	(0.081)
Structural Part		
agrland	−0.008	(0.046)
foodprod	−0.132*	(0.067)
polstab	−0.064	(0.057)
gdpgrowth	−0.001	(0.079)
ruralpopu	0.043	(0.087)
healthexp	−0.136***	(0.051)
sanitation	−0.614***	(0.092)
water	−0.204*	(0.114)
Note:	*z<0.1; **z<0.05; ***z<0.01	

and sanitation is given, the higher food insecurity becomes (negative impact). Growth in rural population (proxy for inequality/poverty as other variables were filtered out on grounds of data availability) is associated with more food insecurity (positive effect). Yet, based on statistical significance and magnitude of standardized effects, only food production, health services and access to sanitation and water indicate an association with food security. The significance of food availability in particular for food insecure countries has been previously shown in Headey (2013). Whilst the provision of health services have been identified as a significant driver for food security in the literature (see e.g. Headey 2013, Smith et al. 2000), access to water and sanitation has rather counter-intuitively not yet been found to do so (Headey 2013; Aurino 2013). In that sense, the results make a contribution in highlighting the importance of improved access to water and sanitation for food security outcomes. Nevertheless, the hypothesized MIMIC is a miss-fit and tentative results can only be taken into consideration with caution.[13]

To conclude, the first suggestion that food insecurity can be constructed as a latent concept with the observable utilization outcome indicators is statistically confirmed for 114 low and mid-income countries in 2010. [14] Yet, the second suggestion that the latent variable food insecurity is horizontally and vertically integrated in the theory driven conceptual framework could for the underlying year and countries, and selected covariates, not be shown.

[13]The model-fit can be slightly improved by dropping the 'non-significant' parameters. The MIMIC model with latent concept*foodinsec* specified as above and covariates *foodprod*, *healthexp*, *sanitation* and *water* has following fit and selection indices: χ^2=66.102*** (*df*=26), RMSEA=0.082, CFI=0.897, TLI=0.845, SRMR=0.071, AIC=3852.192, BIC=3920.597.

[14] Invariance testing across units (groups of countries) should ideally be conducted. Due to limited data availability invariance testing across groups was not feasible. Furthermore, it should be noted that the specified models are most likely not robust over time. Data availability for 114 countries varies across time, and therefore robustness of the model specification across time could not be tested as such.

2.5 CONCLUSION

The theory driven conceptual framework introduced in this Chapter syntheses information on theory, theory driven pillars and indicator levels, further information on aggregation levels and conversion factors. The framework facilitates the identification and justifies the selection of potential food security indicators. By combining and building upon limited frameworks in the literature, this framework offers a coherent, comprehensive and compact overview of the multifaceted and multidimensional concept of food security. Thereby the vertically and horizontally integrated framework indicates that, first, food insecurity is a latent concept which can be measured via the observable pivotal outcome utilization indicators, covering aspects of short and longterm effects of insufficient and inadequate food intake amongst children and pregnant women (taking into account some of the micro conversion factors), plus the progressive realisation of the right to food (multifaceted). Second, the suggested indicators of the remaining dimensions contribute to the explanation of the latent variable food insecurity (multidimensional).

The confirmatory SEM approach employed to test the suggestions, indicates that food insecurity can be measured as a latent concept with the observable multifaceted outcome indicators across 114 mid and low income countries in 2010. However, the interdependence of the framework could with the selected covariates and specified models not be confirmed. Beyond data limitation[15] further indicators as suggested within the different dimensions of the framework should be included; and an analysis across time would be ideal. Furthermore, the framework and the subsequent statistical analysis focuses on domestic drivers. Adding on an international level in the framework which depicts the role of international financial markets including prices (of virtually traded agricultural goods), and the impact of

[15]Imputed datasets might be a good compromise. Here, it would be beyond the purpose of the Chapter, as only original data to understand these and relations amongst in its unmodified form are of interest.

trade and investment relations and regulations, may provide a more complete and therefore better understanding of the multidimensional concept of food security. In the meantime, single outcome indicators as selected in this Chapter might be employed as food insecurity proxies in the applied research. To conclude, given the data limitation and the preliminary findings, measuring food insecurity remains at this stage rather unsatisfactory. Hence, these statistics are hunger statistics by description and beyond.

Chapter 3

The Impact of Regional and Bilateral Trade Agreements on Food Security in Low and Middle Income Countries

Abstract Chapter 3

The Chapter analyses the impact of PTAs on food security across 93 low and middle income countries for 1990-2014 with a Fixed Effects and Dynamic Panel model by controlling for economic, political, social and human rights variables. To take into account some of the multifaceted heterogeneity across PTAs, a distinction is made between Regional and Bilateral Trade Agreements (RTAs and BTAs, respectively) as these are designed differently in the light of food policy. BTAs are often negotiated among asymmetric trading partners in a competitive manner and result in a more 'competitive' design. In contrast, RTAs often entail common policies or objectives on food security and related, and are therefore in comparison more cooperative. Findings of the empirical analysis confirm that having a PTA in force, in contrast to having none, is associated with better food security outcomes. However, an increase in the number of BTAs is negatively, and an increase in the number of RTAs is positively associated with food security outcomes in low and middle income countries.

Keywords: Preferential Trade Agreements / Food Security / Impact Assessment / Low-and Middle Income Countries / Trade Policy

3.1 INTRODUCTION

Food insecurity in terms of absolute figures of undernourished people as estimated by the Food and Agriculture Organization of the UN (FAO) has remained prevalent. About 98 percent of the estimated 795 million undernourished people in 2014-16 live in developing[1] countries (FAO 2015).[2] While under five year old child mortality, another food insecurity indicator, decreased globally by about 53 percent from 1990 to 2015, the mortality rate accounts for still 76 deaths per 1000 live births in low income countries, which is approximately 11 times the average in high income countries.[3] In most developing countries, more than half of the population live in rural areas and the majority's individual income depends on agriculture. Farmers, and particularly small-scale farmers, belong to the group where food is most insecure. The governance of international trade in agricultural goods can be a contributing factor to the state of food security across countries.

Trade in agricultural goods has been increasingly liberalised via amongst others multilateral and preferential trade agreements (PTAs),[4] in particular since the mid 1990s. In their preambles, the WTO establishing agreement (Marrakesh Agreement 1994) and the WTO Agreement on Agriculture (AoA)- both outcomes of the Uruguay Round - make reference to rising living standards and particularly to food security, a then already widely diffused norm. Accordingly, "relations in the field of trade should be conducted with a view to, inter alia, raising standards of living" (Marrakesh Agreement: Preamble). In practice, the multicultural trading system has been arguably more favourable for high income trading partners, in partic-

[1] Unless I make reference to a source which makes use of the terms 'developing' and developed', I prefer the terms 'low and middle income' over 'developing' and 'high income' over 'developed', as these are, in my view, more accurate.

[2] According to the 2015 estimates (based on modified method) of the FAO, as published in The State of Food Insecurity in the World 2015, p. 8. See also FAO (2010) for previous estimates that indicate an increasing trend of undernourishment since the mid 1990. See also Hickel (2016) for a discussion on FAO's modified figures.

[3] See WHO, GHO data.

[4] Please note, that different from the WTO terminology, I use the wording preferential trade agreements as an umbrella term for any trade agreement that is not a WTO agreement (but governed by WTO law in most cases), and therefore preferential to the multilateral trading system (see Appendix B.1 for details and comparative overview of terminology). See also Johns and Peritz (2015).

ular the EU, US and Japan, which continued to subsidize their agricultural exports. Given the managed trade system in practice in contrast to a declared trade system in line with economic principles, it can be argued that while the AoA was intended to increase policy space for food security for its members, it did for high income countries who took advantage of the loopholes within the law, but it restrained policy space for the countries who were already struggling to fulfil their food security obligations (under international human rights law).

The WTO Doha (Development) Round, launched in 2001, has been strained by a political power struggle between the EU and the US on the one side, and the economies now conditioned by the implications of the previous round on the other side - the low to middle income countries backed by rising economies such as Brazil, India and partly China. During the from time to time sticky and stale, and until today un-concluded Doha Round, 'agriculture' remains one of the most sensitive, contentious and controversial issue of negotiations (Richert 2009; Grant 2003, Morrison and Sarris 2007), and proposals on national food security purposes brought forward by a group of low and middle income countries, led by India, has been blocked by the US and remained unresolved.

The slow progress of the ongoing Doha Round is often considered to be one contributing factor to the proliferation of PTAs, which are governed by WTO law [5] on the bilateral and plurilateral/regional level (see, e.g., Grant and Lambert 2008). The WTO counts as of February 2016 454 PTA notifications of which 267 are in force.[6] The new generation of PTAs is compre-

[5] PTAs are governed by WTO rules. An exception to the WTO most-favourite-nation principle is granted by Article XXIV of GATT and the Enabling Clause, latter agreed upon in 1979 (For trade in services Article V of General Agreement on Trade in Services (GATS)). Under Article XXIV of GATT trading partners can enter into preferential trade agreements if these liberalise "substantially all trade" between them. The enabling clause provides a relaxation of the criteria set in Article XXIV allowing for more flexibility with regards to granted preferences in particular for developing countries (Dür and Elsig 2015). PTAs are not checked for compliance as such (Pauwelyn 2009) and there is no agreement on the interpretation of "substantially all trade" - with the effect that all sorts of PTAs are concluded (Pauwelyn 2009). While it is required by Article XXIV of GATT to include agriculture in the PTAs, there is substantial flexibility (Fulponi 2015), with the effect that agriculture is most often treated differently in these agreements (Josling 2009) including the protection for sensitive products (Fulponi 2015) of particular commercial interest (e.g., sugar for EU, rice for Japan, maize for US).

[6] The WTO figures correspond to physical PTAs - counting goods, services and accessions together. The total

hensive and entails provisions beyond mere tariff and non-tariff barrier reduction for trade in agricultural goods, which affect trade in agriculture, such as sanitary and phytosanitary measures, rules of origin, foreign direct investment, services, government procurement, and intellectual property rights. While these provisions are substantially heterogeneous across PTAs (Kim 2015; Baccini, Dür, Haftel 2015; Baier et al. 2015), these tend to establish deeper integration in comparison with the WTO's agreements (Grant and Lambert 2008) according to some authors.

Given the stale negotiations on agriculture and food security on the multilateral level, PTAs with substantial flexibility can potentially have a more direct effect on countries' state of food security - not only by increasing or redirecting agricultural trade flows but also by creating common policies to institutions which promote food security. Nevertheless, agriculture remains the most excluded or exceptionally treated not only in multilateral but also in bilateral and plurilateral trade agreements. The reason lies in the sensitive nature of the agricultural sector and its wider implications for national security (Josling 2009) and food security. Unsurprisingly, agricultural trade remains the most distorted in the world economy (Panagariya 2005), partly, because the domestic agricultural sector is often supported and/or protected from international competitors. This refers especially to bilateral trade agreements (BTAs), which involve two trading partners in the same or not same region, and which tend to be negotiated among often economically unequal trading partners with the apparent mandate to protect and support one's own industry; resulting in 'competitive' design of the agreement text. In contrast, regional trade agreements (RTAs), which have at least three trading partners in the same geographical (sub-)region[7], tend to include provisions on common policy objectives with regards to agriculture and also food security and are therefore considered to be more cooperative.

count is 419 if counted separately. See WTO facts and figures on 'regional trade agreements' (WTO terminology).

[7] At least three participating states can be set as a requirement for its definition (Josling 2009, Bese et al. 2009).

The impact of those trade agreements on food security has remained unclear in theory and practice. The relationship between agricultural trade (liberalisation) and food security (right to food in particular contexts) has been discussed across the literature through multiple disciplinary and methodological lenses. The different lenses condition the views on whether trade is generally seen as an opportunity or threat for food security in theory (normative debate). The opportunity front is often grounded on primarily neo-classical economic theory which demonstrates efficiency gains via liberalisation; ultimately leading to improved food security. On the threat front, the different disciplines developed arguments by combining theory with observations in practice. Accordingly a managed trade regime is influenced by power realities and the implications of this system are outlined in the dependency theory. The implications as outlined in the dependency theory are the macro conditions which contribute to the individual violation of the human right to food of small scale farming families, as argued by human rights scholars and practitioners. The empirical literature has extensively dealt with the implications of liberalisation on economics growth (yet, remained inconclusive) but has neglected to further examine empirically the links between trade agreements as such and its impacts on a coherent food security proxy across countries. Furthermore, no distinction has been made between RTAs and BTAs (or any different type of PTAs), which have on average distinct implications for food security policies.

In this Chapter I distinguish the impact of PTAs on food security outcomes. In detail, after summarizing the debate on trade liberalisation and food security and reviewing the existing literature, I regress food security outcomes on different trade agreement variables across 93 low and middle income countries for 1990-2014 with a Fixed Effects model and Dynamic Panel model (Generalized Method of Moments) by controlling for economic, political, social and human rights variables. The estimation results indicate that, first, having a trade agree-

ment in force, in contrast to having no trade agreement in force, is associated with better food security outcomes. Second, an increase in the number of RTAs is positively and an increase in the number of BTAs is negatively associated with food security outcomes. Given that WTO membership has a negative impact, it can be concluded that the more competitive BTAs can enhance the managed trading system but the more cooperative RTAs retake some of the restricted policy space under the WTO and contribute to better food security outcomes.

3.2 Food Security and International Trade

3.2.1 Contextualising the Debate

Both the concept of food security and implications of the by now very comprehensive trade agreements, evoke an interdisciplinary approach in understanding the contextual background (of the questions raised). Therefore, I refer to the international economics, international public law and political economy literature, to summarize the partly intersecting but also distinct discussion on food security and trade liberalisation in the aforementioned disciplines. The different disciplinary and methodological lenses condition the views on whether trade is generally seen as an opportunity or threat for food security in theory (normative debate).[8] At the same time there is often the acknowledgement that depending on multiple underlying factors such as the level of economic development, the trade balance, the structure of the domestic markets, the characteristics of agricultural producers (FAO 2015b), the regime type (Sen 1999), the absence or presence of conflict (Hendrix 2012; Hendrix and Haggard 2015; Korean and Bagozzi 2017))[9] the impacts of trade liberalisation on food security can play out differently for different trading partners, sectors and income groups across time (long, medium and short term effects). The debate, which has become more polarised over

[8] For an overview of the opportunity and threat debate see Clapp (2015).
[9] A further major influential factors can be the climate.

the years, is in its essence underpinned by the notions of a country's food self-sufficiency and self-reliance in food (Clapp 2015). Self-sufficiency - often advocated on national security and state/political sovereignty grounds, amongst other, - excludes trade, whereas self-reliance sees the integration into the international market as an additional way of ensuring food security by averting risks of food and other shortages (Brooks and Matthews 2015). To lay out the relevant basis for further discussion relevant theories and perspectives in the economics, law and political sciences literature are sketched, after briefly defining food security, elaborating on the right to food and the understanding of trade and trade agreements in this Chapter.

3.2.2 Defining Food Security, the Right to Food and International Trade

In this Chapter, as in Chapter 2, the following definition of food security is referred to. Food security exists when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food that meet their dietary needs and food preferences for an active and healthy life (1996 World Food Summit, 2001 FAO). This implies that people will be food secure if there is sufficient food available (availability pillar), they have access to it (access pillar), and it can be well utilised (utilization pillar) over time (stability pillar) (Brooks and Matthews 2015).[10]

The right to adequate food is an international human right and recognised in the 1948 Universal Declaration of Human Rights (UDHR), as part of the right to an adequate standard of living (Article 25). While it is also referred to in several other instruments under international human rights law (for example, Article 24 and 27 of the Convention on the Rights

[10] For the evolution of the understanding of food security and details on the pillars see Annex B.2.

to the Child), it is most comprehensively dealt with in the 1966 International Covenant on Economic, Social and Cultural Rights (ICESCR), which is binding according to international treaty law. In Article 11(1) of the ICESCR the right to adequate food is recognised as part of an adequate standard of living and is further depicted in Article 11(2) by the wording "fundamental right of everyone to be free from hunger" (Kersten 2016). The key difference to the concept food security is that the right to (adequate) food provides legal entitlements to every individual to be food secure.

International trade can be regulated on the multilateral, plurilateral and bilateral level amongst regional or non-regional trading countries. Trading rules often depict the removal of direct trade barriers in the form of import tariffs (tax levied on imported good), import quotas (quantitative restrictions), export subsidies and taxes, and/or the introduction of standards and regulations, which are aimed to facilitate trade via harmonisation but could in the short-term function in praxis as indirect trade barriers.[11] Altogether these trading rules can contribute to trade liberalisation. If governments, after concluding negotiating details of such arrangements sign the agreed provisions, 'trade agreements', then these constitute (binding) international trade law (Article 2, Vienna Convention on the Law of Treaties).

3.2.3 Trade as an Opportunity for Food Security

The argument for liberalising trade is often founded on economic theory, dating from the classical works of Adam Smith and David Ricardo.[12] Their theories suggest that countries can increase their welfare, when moving beyond autarky, and start trading with each other (given that they trade in accordance to an absolute (Smith) and relative (Ricardo) factor en-

[11] See, e.g,. CARICOM Trade and Food Policy Brief 2001, No. 5, p. 1: "One area of direct impact is compliance with international and industry-driven agricultural health and food safety (AHFS) measures. AHFS creates difficulties for CARICO's food and agricultural exports to enter markets."

[12] Followed by economic models of Eli Hekscher and Bertil Ohlin, and Wolfgang Stolper and Paul Samuelson.

dowment (advantage)) (Dieckheuer 2001). However, since Jacob Viner's (1950) pioneering work on trade creating and diverting effects of preferential trade liberalisation, net welfare effects for participating economies have remained rather ambiguous,[13] in particular when taking the initial situation of trade-distortion (theory of second best)[14] into account (Kersten 2016).[15]

Despite the ambiguity of trade theory in the economics literature, proponents for agricultural trade liberalisation refer frequently to the classical works of comparative advantage only. According to them, trade can - apart from immediate effects of more food supply (quantity and variety) via imports - improve allocation of resources due to a reduction of costs, enhance competition, and increase thereby economic growth, household incomes, and governmental budget for the provision of public services (in essence also the main argumentation line of the modernization theory); and therefore all in all enhance efficiencies and stability for an improvement of food security (Clapp 2015; FAO 2015b). A more differentiated and nuanced view analyses the different channels, categorized by the three pillars of food security (availability, access and utilization) over time (stability - fourth pillar of food security) through which trade may impact on food security (Brooks and Matthews 2014; Díaz-Bonilla et al. 2000; Díaz-Bonilla 2015; Clapp 2015).[16] This more nuanced approach can provide answers within the extreme spectrum of the two positions - trade as an opportunity and trade as a threat (Clapp 2015).

[13] See for example Corden (1988); Chacholiades (1978); Gandolofo (1998); Bhagwati and Panagariya (1996); Krishna (2004); Panagariya (1999/2000); Duttagupta and Panagariya (2003); Baldwin and Venables (1995); and Bhagwati (2002).

[14] According to the theory of second best (Lipsey and Lancaster 1956), it is not possible to ascertain, whether a move to free trade improves or deteriorates the initial trade-distorted situation (Meade 1955).

[15] For more economic theory on customs unions and trade liberalisation in general, see Kemp and Wan (1976), Ohyama (1972), Cooper and Massell (1965), Johnson (1965), Bhagwati (1968), Krishna and Bhagwati (1994), Brecher-Bhagwati (1981), Grossman and Helpman (1995), Krishna (1998), and Bhagwati (1991); see also summaries on these theories in Bhagwati (2008).

[16] See for an example Annex B.2.

3.2.4 TRADE AS A THREAT FOR FOOD SECURITY

The trade as threat narrative has its reasoning rooted in different disciplines, including agroecolocial science[17] (e.g., environmental degradation and loss of biodiversity), sociology (e.g., world-systems and dependency theories, (ecologically and other) unequal exchanges enhancing international inequalities),[18] and human rights law (incoherence amongst or fragmentation of law regimes, focus on rights of individuals particularly the marginalized). The reasoning is therefore far more diverse, and an illustration of such would be beyond the scope of the Chapter. Therefore, I focus on the human rights law perspective adopted by some scholars, experts and non-governmental organizations (NGOs), which partly entails some of the dependency theory arguments.

In principle, liberalising trade has been seen as an opportunity to reduce hunger as, for example, outlined in the Voluntary Guidelines to Support the Progressive Realization of the Right to Adequate Food in the Context of National Food Security, which were developed by an intergovernmental working group, international organizations, NGOs, and representatives of civil society.[19] Yet, human rights scholars, NGOs and others, started to increasingly question whether trade liberalisation contributes to fulfilling the right to food in practice. These views are often based on the observation that import surges, which occur relatively soon after liberalization, have immediate negative effects on mostly small scale farmers' livelihoods in often previously relatively highly protected agricultural import competing subsectors in low and middle income countries. In more detail, the imports from high income countries depress domestic prices, as these are offered at very low prices as directly subsidised by the exporting countries' governments,[20] and consequently reduce mar-

[17] Agroecology combines disciplines such as agronomy, horticulture and ecology, with sociology and economics (Chappell 2015).

[18] See, e.g., Wallerstein (1974/2011), Emmanuel (1972), Hornborg (2001).

[19] Adopted in 2004 by the Food and Agriculture Organization of the United Nations (FAO) Council, the executive body of FAO.

[20] Prices are also influenced by the fact that farming in higher income countries is less labour but more capi-

ket shares of domestic produce or almost entirely crowd these out. Without sufficient public safety nets in place and given the relative inflexibility of the agricultural labour force, the livelihoods including food security of small-scale farmers and their families are and have been severely affected across these countries. The fact that the majority of the food insecure people worldwide are farming families in low and middle income countries, highlights the implicit links between the agricultural sector and trade on the one site, and food security/the right to food on the other site.

While based on economic theory temporary losses are expected in the readjustment phase inbetween trade liberalization and the next optimal (re-)allocation, the above described situation of farming families is from a human rights perspective (focusing on the individual and groups of people) a clear violation of the right to food of the individually affected (against the principle of progressive realisation amongst other).[21] Therefore, the right to adequate food as part of international human rights law and trade agreements as part of international trade law, while often held to be compatible with regard to their declared principles, have been increasingly claimed to be inconsistent with regard to their implementation and consequences. These observations instirred a 15 year still ongoing debate on the normative and institutional relations, or the general nature of relations between international human rights and trade law (Kersten 2016).

The arguments brought forward by the human rights community reflect some points of the dependency theory which has its origins in concerns for low and middle income countries losing shares in the world trade, and turning from food net exporting into food net importing economies since the 1950s. One of the main arguments of the dependency theory in this

tal/technology intensive.

[21] See, e.g., Matthews (2015b) and de Schutter (2009).

context is that developing countries are trapped into continuous worsening terms of trade,[22] because these countries do not export expensive manufactured goods and tariffs are escalated (Hopewell 2016) - i.e., lower tariffs are levied on unprocessed agricultural goods (e.g., pineapples and cocoa) as opposed to processed agricultural goods (e.g., pineapple juice and chocolate) (ICTSD 2009).

Conclusively, the claim can be made that the (de-)regulation (but in fact regulation) of trade does not necessarily prevent asymmetric allocation of trade outcomes; in contrast, it can be even instrumental in market distorting practices instead of living up to free market principles. Scholars in the political sciences/political economy literature therefore explain that the regulation of trade is rather determined by political realities of (economic) power. Accordingly, states with economic power are able to impose their preferred ('managed') trade regime (Luterbacher and Norrlöf 1999) in their favour (Hopewell 2016) partly influenced by lobbying efforts of special interest groups (Buzard 2016).

3.2.5 Inconclusive Empirical Literature and Lacunae

The vast empirical literature on the impacts of PTAs, in general, remains inconclusive. Literature reviews show how widely estimates can vary (Jean and Bureau 2016). This can be due to different modelling (gravity models in most cases), problems with endogeneity due to missing variables and unaccounted heterogeneity across agreements (Jean and Bureau 2016; Kohl 2014; Baier et al. 2015; Hicks and Kim 2012). Beyond the agreement design[23] and level of integration (type of trade agreement)[24] - and a combinations of these to proxy

[22] However, see also Panagariya's (2005) theoretical rebut on impacts of agricultural liberalization on least developed countries.

[23] Baccini, Dür and Haftel (2003) summarize that variation in the design of trade agreements is explained by some studies based on regime type, interest groups, or political stability (Düer 2007; Kucik 2012; Mansfield, Milner and Rosendorff 2002) and by other studies based on regional factors, such as economic interdependence and the balance of power (Haftel 2013; Johns 2013; Smith 2000).

[24] The degree of integration amongst trading partners can be distinguished in five forms (listed by increasing degree of integration): 1) Preferential Trade Area or Arrangement (also generic term for all following forms), 2)

the depth of liberalisation (Baccini et al. 2013, Dür et al. 2014) -, further factors and characteristics of trade agreements might have different implications and render these even more heterogeneous in praxis.[25] The number of trading partners for each agreement (breadth), the number of agreements concluded by each trading partner including the partly overlapping agreement (network) structure of hubs and spokes[26] (ties and nodes)[27] (Barabási and Bonabeau 2003; Pauwelyn and Alschner 2015), and the geopolitical setting and location of the trading partners - besides each country's economic, political condition, governance and infrastructure. All these factors, can contribute to determining the efficiency of the agreement over time (Gray and Slapin 2012, Pauwelyn and Alschner 2015).

A recent study by Jean and Bureau (2016), which tries to countervail the shortcomings of previous studies by taking into account some of the above, reports an average increase for agricultural and food exports based on an analysis of 74 agreements for the 1998-2009 period. Trade flows might provide some, however, not sufficient indication, such as the interim variable 'economic growth' (for which there is paramount empirical literature) - for food security outcomes, which is the dependent variable of interest in this Chapter.[28]

There is substantial literature on the impacts of agricultural trade liberalisation on food se-

Free Trade Area or Arrangement, 3) Customs Union, 4) Common Market, 5) Economic Union (Chacholiades 1978, Gandolfo 1998)

[25] See Johns and Peritz (2015) on details of trade agreement desig (depth, scope, flexibility, breadth and institutionalization).

[26] The hub is the country that has several PTAs with other countries, the spokes (Kowalczyk and Wonnacott 1992), and is therefore in an advantageous position due to better access to all of its free-trading partners (Gandolfo 1998). Welfare implications for existing spoke countries depend, according to Kowalcyzk and Wonnacott (1992), on the exports of the new spoke country in relation to the exports of old spoke countries. In the case of complement export products, initial PTA partners of the hub gain. In the case of substitutes initial spoke countries might lose by a decreased degree of preference in the hub market (Kowalczyk and Wonnacott 1992).

[27] "Power law distribution also has an effect on diffusion within the system. New norms that are adopted by hub countries are more likely to spread within the network than is legal innovation undertaken by peripheral members" (Pauwelyn and Alschner 2015: 506).

[28] For implications of PTAs on civil and political human rights, see Hafner-Burton (2005), Spilker and Böhmelt (2012); and for implications of Bilateral Investment Treaties on civil and political human rights, see Bodea and Ye (2015).

curity for single countries[29] and/or regions.[30] In a systematic screen of this literature (1,176 articles identified in total), 34 empirical mostly single country (and a few group 'developing countries' or 'low-income countries') studies ex ante or ex post assessment for different periods were selected for a meta-analysis/review (McCorriston et al. 2013). Findings across the studies are inconclusive. Furthermore, the fact that the dependent variable of interest,[31] metric to operationalise food security, varies and depicts different pillars (access, availability and utilization) of the food security concept across the mostly single country studies, does not set a valid basis to draw any tentative conclusions from the comparison. For a coherent cross-country comparison a harmonized country-level proxy for food security is needed.

There are two recent empirical studies which apply such a proxy for food security. Olper et al. (2014) assess how the child mortality rate (utilization pillar) changes if the trade liberalization index (based on Wacziarg and Welch 2008) changes for 80 developing countries for the period 1960-2010. Bezuneh and Yiheyis (2014) estimate changes in per capita daily dietary energy supply (availability pillar) for every trade liberalization episodes, which are compiled by Li (2003), for 37 countries in the 1980s and 1990s. In both studies, results are relatively mixed, but indicate some improvement (at least in the longer run; in Bezuneh and Yiheyis (2014), yet, not significant) for food security. The food security metrics and the trade liberalization proxies differ across the studies. Furthermore, the trade liberalization proxies do not depict trade agreements. Therefore, liberalisation due to different types of agreements remains unaccounted.

The review of the empirical literature highlights a lacunae: first, the impact of PTAs on one (coherent and) harmonized food security proxy across countries, and years, in the context as

[29] See McCorriston et al. (2013) for a list of examples.

[30] See, e.g., Herath et al. 2014 for ASEAN; and Nega 2015 for Africa.

[31] E.g., quantity of food requirement, per capita food supply, malnutrition, calorie intake, food insecurity threshold, underweight, import dependence.

outlined above; second, the differentiation of trade agreements in the light of food security outcomes. In the following subsection it is explained why differentiating between RTAs and BTAs is particularly relevant for understanding the impact on food security.

3.2.6 Regional and Bilateral Trade Agreements, and Policy Space for Food Security

Given the comprehensive provisions of the PTAs, the heterogeneous design across the agreements and overlapping structure of provisions (e.g., overlapping tariff-phase-out schedules), it is not feasible to assess the distinguished impact of PTAs on the different food security pillars in all its complex combinations and possibilities.[32] Furthermore, for the question of interest, PTAs which include provisions on agriculture, may be seen as the only relevant category. However, as already indicated, provisions, other than agriculture, can potentially impact agricultural trade and food security, and therefore PTAs which include or do not include provisions on agricultural trade are considered here. To take into account some of the heterogeneity across PTAs, these are distinguished into RTAs and BTAs as these can have potentially distinct implications for food security for the following reasons.

RTAs[33] have a complex set of economic and political objectives (Fulponi 2015). In detail, whilst market access remains a key factor, the rationale of RTAs is often increasing regional cohesion, e.g., in agricultural policy, and policy coordination (Josling 2009; Fulponi 2015) such as health and safety standards (Fulponi 2015), and the objective of enhancing food security (Josling 2009) amongst others. While the agreements are often "relatively flexible, allowing for varying levels of legal commitments and differing approaches to trade policies"

[32] For an overview of the different provisions and their potential paths of effects on the first three pillars of food security see Appendix B.2.

[33] RTAs are generally reciprocal, but some have special treatment for low-income partner countries (Josling 2009). Here, only reciprocal RTAs will be considered because the implications of symmetric obligations are of prime interest in this Chapter and because non-reciprocal are often constrained anyway "when sensitive domestic industries (such as agriculture) are involved" (Josling 2009: 144).

because of their need to balance numerous objectives (Fulponi 2015:5), these are of a highly cooperative nature (Bese et al. 2009). In the light of food security, RTAs often refer explicitly to food security as an aim or even to common food security objectives/programmes to be implemented. Furthermore, agricultural policy is in most cases included in the provisions, ranging from an intended cooperation and/or harmonization of policies to a common agricultural policy.

In contrast, BTAs, aimed at trade expansion via market access, do not intend to establish a common (agricultural) policy and are relatively more competitive. The negotiation of provisions on agriculture are most likely influenced by power dynamics and can therefore pose both problems and opportunities (Josling 2009). Often BTAs are negotiated amongst asymmetric trading partners with the result that the higher income country is "likely to be able to shelter sensitive import-competing sectors and to impose an agreement that favours its export interests" (Josling 2009:144). Accordingly, the nature of the agreement text and the implications will depend to a large extent on the commercial interests of the higher income country (Josling 2009).

In conclusion, lower and middle income countries may not be able to benefit in areas in which the more powerful negotiation partner has its key interests. Particularly, trade in agricultural goods may be sensitive as outlined above. Therefore, it is likely that lower and middle income countries potentially face on average adverse implications of such BTAs in the light of food security. Furthermore, BTAs do not entail provisions on common objectives or aims for cohesion on food security, agricultural policies or other as can be found in RTAs and as mentioned above. The right to food or similar wording is in none of the PTAs texts included. If a human rights clause is entailed (mostly PTAs with EC/EU), than these refer rather to political and civil rights and not to economic, social and cultural rights.

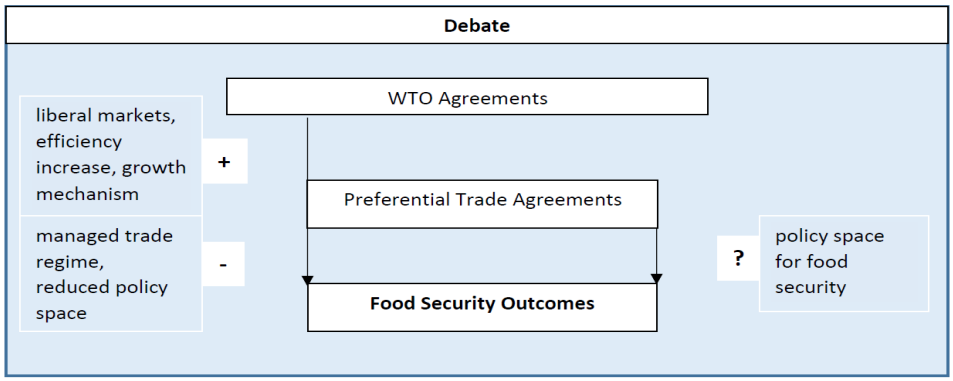
In conclusion, RTAs are on average relatively more cooperative than BTAs in principle. While BTAs among asymmetric trading partners may enhance the managed trade regime due to power relations (Luterbacker and Norrlöf 1999), RTAs can with common policies and objectives countervail the restricted policy space[34] set by the multilateral framework.

3.2.7 Question and Research Design

To reiterate and set the research question, I rephrase the conclusion above. Given the general assumption that the Uruguay Round policy outcome is a managed trade regime, to the disadvantage of mainly low and middle income countries in terms of food security, then it can be stated that the policy space for food security of those governments is constrained. In the light of the proliferation of PTAs, have those PTAs regained or created policy space to contribute to better food outcomes, and does the type of trade agreement, i.e. RTA or BTA, make a difference? Figure 3.2.1 provides an overview of the question contextualised in the debate between theory (potential positive effects on food security outcomes, indicated by a plus sign) and practice (potential negative effects on food security outcomes, indicated by a minus sign).

[34] In the trade agreement and food security context, policy space refers to the autonomy/room of manoeuvre available to countries to implement food security enhancing policies including budget expenditures which are not constrained by multilateral, plurilateral, bilateral and/or regional trading rules (See for a more general definition Matthews (2015a and 2015b).).

Figure 3.2.1: Model Context



Having a PTA (governed by but an exception to the WTO rules) in force can potentially retake some initial room manoeuvre for food policy and is therefore associated with better food security outcomes. The focus here is on the comparison of having a PTA in force to having none in place given the multilateral trade system.[35] The PTA is expected to re-take/create some of the policy space, no matter whether it is a BTA or RTA. Accordingly, I formulate the first hypothesis as follows.

H1: *A PTA in force, in contrast to having no PTA in force, is associated with better food security outcomes.*

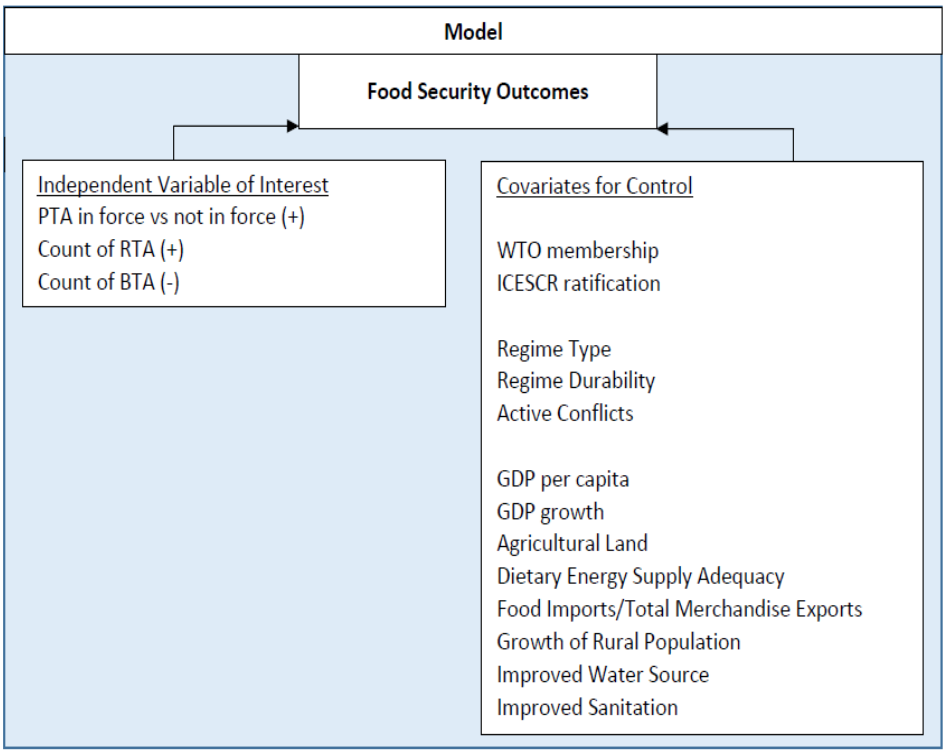
Yet, whether an increasing number of PTAs is increasingly beneficial for food security depends on whether these are relatively cooperative or competitive. Therefore, PTAs need to be differentiated and the second hypothesis is stated takes into account the heterogeneity of PTAs.

H2: *RTAs contribute to improving food security, whereas an increasing number of BTAs is counter-productive.*

[35] This implies that the following analysis does not measure what the impact of one PTA (be it RTA or BTA) is.

The details of the model are presented in Figure 3.2.2. Accordingly, in line with the hypotheses 'Food Security Outcomes' (of the utilisation-outcome dimension of the food security framework as introduced in Chapter 2) are positively associated with a country having a PTA in force. The effect of the increment of the number of PTAs depends on whether it is a RTA or BTA. The more cooperative RTAs are positively associated with food security, and the more competitive BTAs negatively.

Figure 3.2.2: Model Overview



To start with the first covariates of control, WTO membership can be negatively associated with food security outcomes in practice, as discussed above, and the ratification of the ICESCR positively. While it has not been assessed whether the ratification of ICESCR leads to positive economic, social and cultural human rights outcomes, the literature on the impacts of human rights treaties on civil and political human rights indicates that these treaties do

have the intended effect.[36] The positive relationship between democracy (see regime type and durability) and food security has been established in the theoretical and empirical literature, most prominently by Sen (1999).[37] Violent conflict can be a major driver of acute food security (Hendrix and Brinkman 2012).[38]

The remaining cluster of covariates are all food security indicators themselves given the framework introduced in Chapter 2 (see also Annex B.2). Yet, these are of another dimension than the utilization-outcome dimension (see Chapter 2 for details). Given the framework's logic of the horizontally and vertically interdependence, these indicators are drivers for food security outcomes of the utilisation-outcome dimension, and therefore function well as controls (see also Chapter 2 and 3).

Food availability is depicted via agricultural land (structural), dietary energy supply adequacy and food imports over merchandise exports (both outcome). GDP per capita and economic growth rates, structural indicators under the availability and access pillar, are both positively associated with food security outcomes. The more agricultural land and dietary energy supply is available, the better are the ultimate food security outcomes of the utilisation outcome dimension. The latter variable, food imports over merchandise exports, not only reflects food availability but also depicts the purchasing power for food imports in terms of merchandise exports (i.e., foreign exchange reserves to pay for food imports), and therefore presents the access pillar as well. The greater the merchandise export flows of a country the more affordable food imports become. According to the dependency theory, in particular lower income countries (exporting mainly unprocessed agricultural goods) have

[36] See, e.g., Fariss (2014 and forthcoming) for mainly civil and political human rights and related documents. Fariss' analysis does not include economic, social and cultural human rights.

[37] See also Marshall and Jagger 2002, but note that there are critiques and differentiated views to this main strand.

[38] Reversely, Food security can be a driver for unrest and conflict. See, e.g., Hendrix 2012, Hendrix and Haggard 2015, Koren and Bagozzi 2017.

on average a low ratio, negatively affecting food security outcomes.

Given that most of the food insecure live in rural areas, the lower the growth for the rural population, the better are the average food security outcomes. The latter variable is an indicator in the access-outcome dimension. To control for other dimensions under the utilization pillar, improved sanitation and access to water sources, are added which contribute positively to food security outcomes of the utilization-outcome dimension. These variables are further described in the context of their concrete measure in the following section.

3.3 Data, Measurement and Method

3.3.1 Dataset

The pooled, cross-section, time-series dataset includes variables for 93 low and middle income countries, for 1990-2014.[39] Despite basing the case selection on data availability amongst other criteria, some observations of the covariates are still missing at random (see Annex C.5 for Pattern of Missings). Therefore, the missings (at random) in the original dataset were imputed.[40] All models are fitted based on the strongly balanced imputed dataset with 2325(=N*T=93*25) observations.

I describe the variable of interest, food (in-)security, the explanatory variables, trade agreements, and the covariates for control in the following, before elaborating on the structure of the dataset and the estimation method in more detail. The descriptive statistics for all variables, of which all numerical values were last updated 25th October 2015, are reported in

[39] The process of case selection is based first on data availability. Second, one case for which the dependent variable, food security, has a strongly differing time series pattern (e.g., Haiti in 2010) is taken out, so as islands of Oceania which show a different pattern in the relation of food security and trade agreements in comparison to other regions. Third, further outliers are omitted.

[40] Imputations were run 100 times by semiparametrically estimating the parameters of a Gaussian copula with R package sbgcop (Hoff 2015). The means of 100 imputations for each variable constitute the dataset. This method was chosen over other methods and R packages for reasons given in Hollenbach et al. 2017.

Annex B.4 (original dataset with MAR) and Annex C.5 (imputed dataset).

3.3.2 Variables and Measurement

Food (In-)Security[41]

The dependent variable of interest, food security is proxied with child mortality. In Chapter 2 I have shown the complexity of the concept food security and introduced a framework which facilitates the identification of relevant food security variables (See Annex B.2. See also Chapter 2 for an introduction.) According to this framework, utilisation-outcome variables are the variables measuring the actual realisation of food (in-)security. Child mortality is one of the identified outcome-utlization variables. The indicator child mortality reflects apart from individual outcomes under the utilization pillar complementary factors on the macro level (some of the control variables). Furthermore, child mortality is highly correlated with other food insecurity proxies of the utilization-outcome dimension such as anthropometric and biochemical indicators (see Annex B.2). Even though high correlation might not suggest interchangeability as Caspers and Tufis (2003) have shown in the context of democracy measures, in this context child mortality might reflect the other utilization-outcome variables well. For instance, child deaths are found to be attributable to undernutrition in low and middle income countries (Black et al. 2013).[42] Based on these reasons (besides data availability) the dependent variable of interest food security are proxied with child mortality as, for exmaple, done in Olper et al. (2014).[43]

Child mortality is the mortality rate among children and describes more precisely the prob-

[41] Sourced from World Bank. Data provided by UN Inter-agency Group for Child Mortality Estimation (UNICEF, WHO, World Bank, UN DESA Population Division).

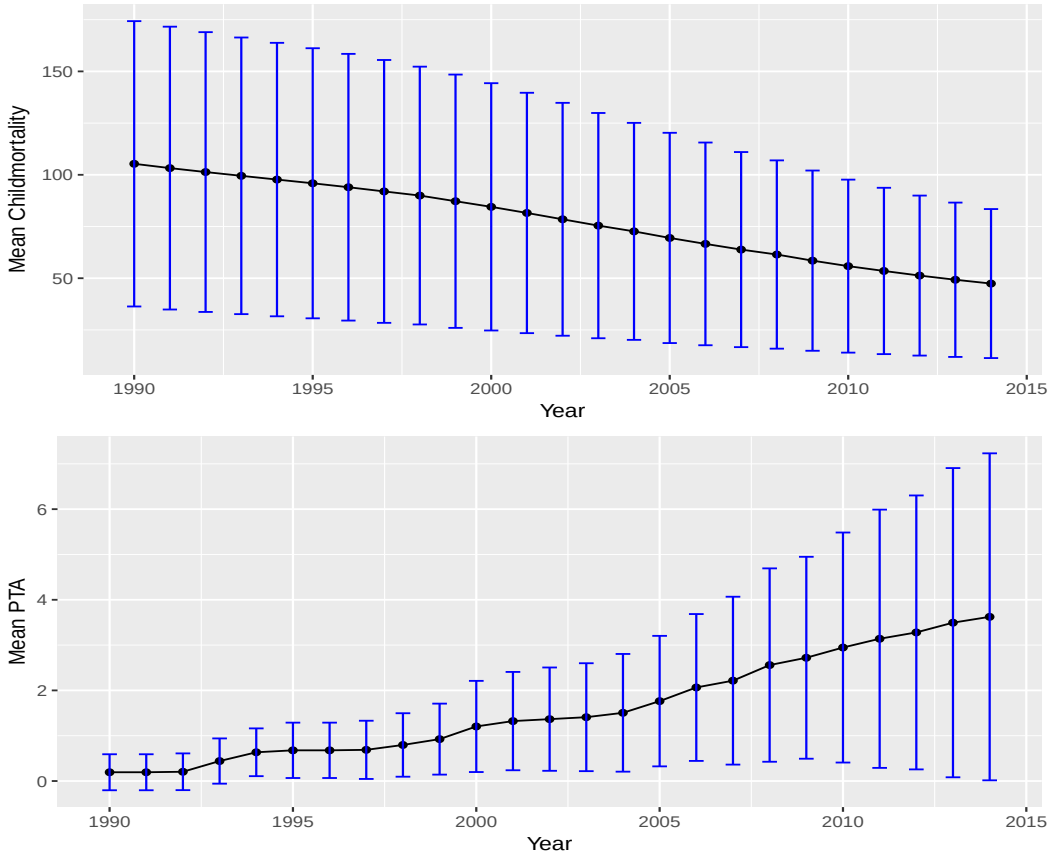
[42] See also Campbell et al. 2009, who have shown that higher household food insecurity in Indonesia is associated with higher child mortality.

[43] Child mortality, or other anthropometric variables, are referred to in the literature as a food security proxy. See, e.g., Olper et al. (2014) and McCorriston et al. (2013).

ability per 1,000 that a newborn dies before year five (0-4 years) (Chapter 1). Accordingly, the dependent variable depicts not food security but *Food Insecurity* and therefore all effects as listed in Figure 3.2.2 are reversed. For example, according to theory it is expected that RTAs are negatively and BTAs are positively associated with child mortality.

The mean (across countries) of child mortality plus/minus one standard deviation over time is presented in Figure 3.3.1. Child mortality is not logarithmized despite its skewed distribution to allow increments of higher values to weigh more heavily.

Figure 3.3.1: Mean and Standard Deviation of the Variables of Interest over Time



PTAs[44]

There are four variables depicting PTAs as the main independent variables of interest. The first variable, *PTA Dummy*, is a dummy indicating whether a country has (value=1) or has not (value=0) a PTA. The second variable, *PTA*, depicts, the cumulative count of all trade agreements in force for each country in a given year. The third and fourth variable, *RTA* and *BTA* respectively, are in the first case the cumulative count of all RTAs and in the second case of all BTAs in force for each country in a given year.

All PTAs in force (beyond the WTO notification list) were screened and selected according to the following positive or negative criteria. Trade agreements, that have at least one party as a low or middle income country are included (i.e., trade agreements with high income trading partners only are excluded). Trade agreements with European countries (as defined by UNSTAT, i.e. including European countries outside the EU custom union) only, are excluded. Trade agreements among or with a former Soviet State are excluded as these transition economies constitute economically specific cases. Highly inefficient trade agreements such as the Arab Maghreb Union and trade agreements that are no longer in force as of today [45] were taken out to reduce overall complexity.[46] Only reciprocal trade agreements are included (i.e., no partial scope agreement and/or in WTO terminology preferential arrangement agreements are included). Some trade agreements cover trade in goods only.

All trade agreements in force for each country in a given year are shown in Figure 3.3.1. Figure 3.3.2 shows the mean (across countries) of RTAs and BTAs over time. The graph highlights that a country has on average less RTAs than BTAs, and the latter increased over time. This

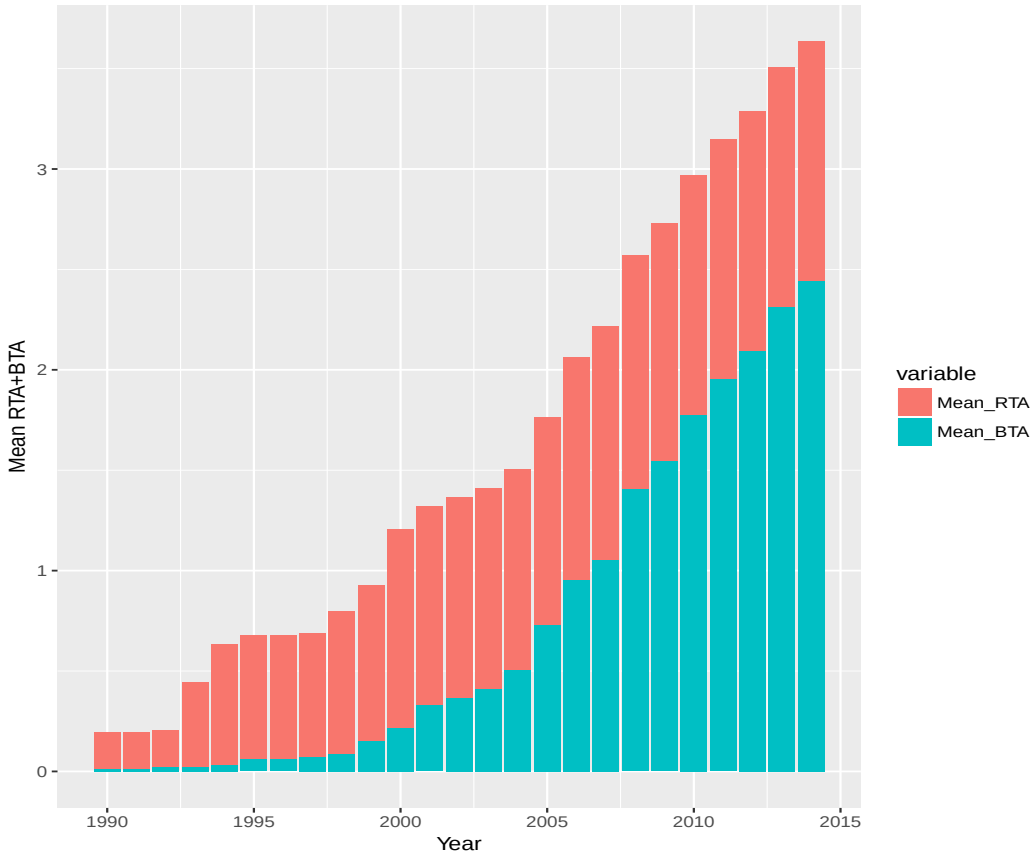
[44] Own coding based on comparatively compiled PTA list given WTO RTA-IS database, McGilll RTAs and PTAs database, SICE Foreign Trade Information System, Asia Regional Integration Center, UN Commission for Africa.

[45] Exception is made for Venezuela and MERCOSUR. Venezuela left MERCOSUR December 2016.

[46] It would be more accurate to take into account all historical trade agreements. Yet, to reduce the number of inefficient trade agreements these are not considered. Furthermore, if left in, the degree of efficiency should be controlled for, which is rather challenging to operationalise in this context.

indicates that the *PTA* variable will be stronger correlated with the *BTA* variable than with the *RTA* variable. Given the relatively constant mean of *RTA*, the *RTA* variable is expected to be stronger correlated with the *PTA Dummy* than with the count of the PTAs variable *PTA* (see Annex B.4 for correlation coefficients).

Figure 3.3.2: Mean of RTA and BTA Variables (Number of PTAS) over Time



For a presentation of the bivariate relationship between the dependent and key independent variables please refer to Figure B.4.5 (correlation matrix) and B.4.6 (scatter plots) in Annex B.4.

WTO Membership[47]

The WTO membership dummy variable, *WTO*, indicates whether a country is a member to

[47] Own coding based on WTO membership list.

the WTO (value=1) or not (value=0) in a given year. It means that the value of the WTO variable can change over time for a country.

ICESCR Ratification[48]

The ICESCR ratification ordinal variable, *ICESCR* denotes whether a country ratified (value=2) or signed (value=1) the UN Convention on Economic, Social and Cultural Rights, or none of the aforementioned. The reason to chose an ordinal rather than a dummy variable (ratified or not) is twofold. First, in principle, a signature subject to ratification does express the willingness of the signatory state to ratify and it creates an obligation to refrain from acts that would defeat the object and purpose of the treaty (Article 10 and 19, Vienna Convention on the Law of Treaties). Ratification creates the obligation to be bound to the treaty (Article 2(b) and 14, Vienna Convention on the Law of Treaties), which in principle can therefore have a stronger positive impact on the right to food. The second reason is methodological. An ordinary variable allows potentially for more within variation than a dummy variable.

Regime Type and Duration[49]

Polity IV is the rescaled Polity IV variable depicting regime type (strong autocracy to strong democracy) on a scale 0 to 1 (from original scale -10 to 10), ranging from strongly autocratic to strongly democratic.[50].

The variable regime durability, *Reg. Durability*, describes the number of years since the most recent regime change (Polity IV Project: Dataset Users' Manual v2016: 17).

Armed Conflicts[51]

[48] Own coding based on UN Treaty Collection List.

[49] Source: Polity IV Project.

[50] See (Polity IV Project: Dataset Users' Manual v2016: 16-17

[51] Source: UCDP Monadic Conflict Onset and Incidence Dataset (Harbom and Wallensteen 2012; and Gleditsch, Wallensteen, Eriksson, Sollenberg, and Strand 2002).

The variable *Conflict* denotes the number of active armed conflicts (internal and internationalized internal) in a country for a given year.[52]

Controls derived from the Food Security Framework[53]

The variable *Log(GDP)* is the logarithm of real (constant 2011 international dollar) GDP per capita based on purchasing power parity (PPP) for better cross country comparison.[54] GDP per capita is logarithmized, not primarily to control for skewness of the distribution, but to allow for similar effects of increments along minimum to maximum values. GDP growth (in percentage) is the annual GDP (in local currency) growth rate per capita.

The variable agricultural *Land* (sourced from WB but originally from FAO) is the share of land area that is arable (in percentage).

Dietary energy supply adequacy[55] is the energy supply (calories for food consumption) for a country divided by the average dietary energy requirement of the population (percentage, 3-year average). Accordingly, rather than just providing information on the quantity, it indicates whether the supply is sufficient in relation to the population.

The variable food imports over total merchandise exports[56] (percent, 3-year average) has comparatively high values for particularly lower income countries, given that these have relatively low merchandise export flows. Therefore, to adjust the high values to a lower scale, and to take account for the skewed distribution (lesser reason), the logarithm is taken of this variable, and named *Log(Food/Merchandise)*

[52] Readme file for the UCDP Monadic Conflict Onset and Incidence Dataset.
[53] All sourced from World Bank or FAO; original data provided by different agencies.
[54] Source: World Bank Development Indicators.
[55] Source: FAO.
[56] Source: FAO.

The variable *Rural Population Growth* (annual percent)[57] is the growth rate of the share of the population living in rural areas as defined by national statistical offices and calculated as the difference between total population and urban population.

Improved sanitation facilities[58] depicts the percent of population using improved sanitation facilities; and presented by variable *Sanitation*. The variable improved *Water* source[59] refers to the percentage of population with access to an improved drinking water source. The distribution of the variable is skewed. However, to keep the variable on the percentage scale as the rest of the 'food-security' covariates for control and to make it more comparable to the related variable sanitation, the values of the variable are not transformed.

3.3.3 Estimation Model and Method

I fit three (restricted) Fixed Effects models on the strongly balanced cross-country time series data to control for further unobserved country-specific effects on food security.[60] The full[61] linear fixed effects model for country i=1,...,93 and year t=1,...,25 is presented in the following. For the first restricted model, *model (1)*, only the $PTAD_{it}$ variable out of all main independent variables ($PTAD_{it}$, PTA_{it} RTA_{it} and BTA_{it}) is included, i.e. parameters γ_2,γ_3 and γ_4 are set to zero. For the second restricted model, *model (2)*, it is variable PTA_{it}, i.e. , parameters γ_2, γ_3 and γ_4 are set to zero; and for *model (3)* the variables are RTA_{it} and BTA_{it},

[57] World Bank estimates based on UN World Urbanization Project.

[58] Sourced from World Bank. Original source is WHO/UNICEF Joint Monitoring Program for Water Supply and Sanitation.

[59] Sourced from World Bank. Original source is WHO/UNICEF Joint Monitoring Program for Water Supply and Sanitation.

[60] Hausman test statistically confirms that Fixed Effects model is to be preferred over Random Effects model. Moreover, Fixed Effects model is the only option out of the two, as the moment/strict exogeneity condition most likely does not hold.

[61] The full model is noted here for efficient presentation purposes. Substantively and methodologically the full model is not sensible (different data generating processes for the main independent variables and multicollinearity).

i.e. γ_1 and γ_2 are zero.

$$\begin{aligned} FIS_{it} =& \alpha_i + \gamma_1 PTAD_{it} + \gamma_2 PTA_{it} + \gamma_3 RTA_{it} + \gamma_4 BTA \\ &+ \beta_1 ICESCR_{it} + \beta_2 WTO_{it} + \beta_3 POLITY_{it} + \beta_4 RDUR_{it} + \beta_5 CONF_{it} \\ &+ \beta_6 Log(GDP)_{it} + \beta_7 Log(GDPGR)_{it} + \beta_8 LAND_{it} + \beta_9 SUPPLY_{it} \\ &+ \beta_{10} FOMEit + \beta_{11} RPOPGR_{it} + \beta_{12} SANITATION_{it} + \beta_{13} WATER_{it} + u_{it} \end{aligned} \tag{3.3.1}$$

FIS_{it} is the dependent variable food insecurity; α_i is the unobserved individual country effect; $PTAD_{it}$ is the main independent variable for *model (1)*, which is a dummy variable with value=1 if a PTA is in force and value=0 otherwise; PTA_{it} is the main independent variable for *model (2)*, which is the cumulative count of PTAs; RTA_{it} and BTA_{it} are the main independent variables for *model (3)*, which depict the cumulative count of RTAs and BTAs, respectively; $ICESCR_{it}$ is the ICESCR ratification variable; WTO_{it} is a dummy on WTO membership; $POLITY_{it}$ is the Polity IV variable; $RDUR_{it}$ is the regime durability variable; $CONFLICT_{it}$ is the conflict variable; $Log(GDP)_{it}$ is the GDP per capita variable; $GDPGR_{it}$ is the GDP per capita growth variable; $LAND_{it}$ is the agricultural land variable; $SUPPLY_{it}$ is the dietary energy supply variable; $FOME_{it}$ is the values of food imports divided by values of merchandise exports variable; $RPOPGR_{it}$ is the rural population growth variable; $SANITATION_{it}$ is the improved sanitation variable; $WATER_{it}$ is the improved water source variable; u_{it} is the error term.

After controlling for unit heterogeneity in the Fixed Effects model,[62] (results are presented under the following section in Table 3.4.1), there is still heteroskedasticity (Breusch-Pagan test) and also autcorrelation (Breusch-Gorfrey, Wooldrdige and Durbin-Watson test) in the errors. Therefore, to correct for heteroskedasticity and serial correlation I employ a robust

[62] See for results of Mixed Effects model with Random Intercepts, which are similar to the Fixed Effects Model estimates, Annex B.6.

covariance matrix according to the White (1980, 1984)[63] [64] and the Arellano (1987) method, clustered over countries. Results for robust standard errors are presented under the following section in Table 3.4.2.

Furthermore, to correct alternatively for violations of the Gauss-Markov assumption and to generally specify an alternative model for robustness [65], I fit an Arellano-Bond dynamic model (General Method of Moments) with adjusted standard errors for clustering on country (one-step, differences as instruments). Alternative dynamic models with additional moment conditions (instruments for level equation: lagged level of dependent variable) show robust results for all key independent variables and are therefore not presented. Provisions within the trade agreements texts, and other independent variables (covariates) can have immediate to medium term impacts (within a year), and therefore I first present estimation results of models with a contemporaneous impact of independent variables. Based on these results I specify a further dynamic model in which I lag some of the control variables. If the Nickell-Bias is relatively small given that the number of time periods is relatively small , then an alternative model is the Fixed Effects Model with a lagged dependent variable. The estimates (with robust standard errors) are presented in Table B.6.2 in Annex B.6 and compared with outcomes of the Arellano-Bond dynamic model.

3.4 RESULTS

Estimates of the Fixed Effects model with and without an adjusted variance-covariance matrix for robust standard errors, are presented in Table 3.4.1 and 3.4.2, respectively. The estimates of the Dynamic model are presented in Table 4.4.2 and 4.4.3.

[63] Based on Eicker 1963.

[64] Here, adjustments for small/finite samples according to MacKinnon and White (1985) amongst other did not lead to significant differences in the standard errors. Therefore, the simple weighting for the variance-covariance matrix is applied.

[65] Other reasons are that the robust standard errors more than double in the Fixed Effects model. This can potentially be an indication for a misspecified model according to King an Roberts (2015).

The independent variables of interest have, in line with the hypotheses, following direction of effect across the Fixed Effects and Dynamic model (indicating robustness): *PTA Dummy* is negatively, *PTA* positively, *RTA* negatively and *BTA* positively associated with *Food Insecurity*. Conclusively, in line with the hypothesis having a trade agreement in contrast to having no trade agreement, can improve food security. However, an increasing number of trade agreements does not necessarily translate into better food security outcomes. The direction of effect is conditional on the type of trade agreement. An increasing number of RTAs has positive impacts and an increasing number of BTAs adverse impacts on the dependent variable. The results reflect that the variable *PTA Dummy* is strongly correlated with *RTA*, and variable *PTA* with *BTA*. Furthermore, the key independent variables of *model 3*, *RTA* and *BTA* are significant in the Fixed Effects and Dynamic models.

In light of these results and the direction of effect of the estimated coefficient for the *WTO* variable (negatively associated with food security in the Fixed Effects and Dynamic models), it can be interpreted that having a PTA (in contrast to having no PTA), counter-effects the multilateral constraints on food policy space. Yet, an increasing number of BTAs, enhances the managed trading regime and increases negative impacts. In contrast, RTAs countervail and create policy space for food security. Across the models, the magnitudes of the effects show that an increase in the cumulative number of RTAs is more than countervailing the negative effect of WTO membership, and an increase in the number of BTAs has less than a third of the effect as an increment in the number of RTAs.

The direction of effect of the estimated coefficient for *ICESCR*, is positive (and not-significant) for the Fixed Effects specification, but has a positive and significant effect on food security (or negative effect on *Food Insecurity*) across the Dynamic *models (1)-(3)*. It indicates that the

implications of the ICESCR are undetermined across the Fixed Effects and Dynamic models. However, if the criteria of significance is given importance, then it can be argued that the ratification of the covenant which entails the right to food contributes positively to the realisation of the right to food.

All other estimated coefficients (covariates) have the expected direction of effect in the Fixed Effects specification as discussed above. The more democratic and politically stable (in terms of regime durability) a country is the better the food security situation. Armed conflict has adverse impacts. The income of a country (GDP per capita), foreign exchange reserves to pay for food imports (merchandise exports/food imports) and economic growth (all food security indicators under the availability and access pillar) are positively associated with food security outcomes. The more agricultural land and energy supply in relation to population are available (availability pillar), the lower is the child mortality rate. The lower the growth for the rural population (access pillar) who are among the most food insecure, the better are the average food security outcomes. Improved access to sanitation and water sources, has a positive impact on food security.

In the dynamic specification as presented in Table 4.4.2 the direction of effect flips for five of the control variables, namely *Conflict, Log(GDP), Log(Food/Merchandise), Rural Population Growth* and *Sanitation*. It could be argued that these variables are sluggish in comparison to the other controls. For example, at the start of a conflict food security might not be immediately affected; a decrease in the rural population might not immediate translate into improved food security; and the effects of improved sanitation might not show as quickly as the improved access to water. There is less substantial reason for income (GDP and purchasing power for food imports) to have a sluggish effect. Nevertheless, I lag these as well by one period (i.e. one year). Furthermore, the ratification of the ICESCR can have assumably

delayed effects, and therefore I lag the variable as well as presented in Table 4.4.3.

The impact of the lagged *ICESCR* remains positive on food security (and significant). While the direction of effect for variables *Log(GDP)*, *Log(Food/Merchandise)* and *Sanitation* remains the same when lagging by one period, these change for *Conflict* and *Rural Population Growth* in line with theory.

If the number of time periods is sufficiently large so that the Nickell-Bias is approximating zero, then the estimates of a Fixed Effects model with a lagged dependent variable (and robust standard errors) might be of relatively good quality (small bias and efficient) and can be compared to the coefficients of the Dynamic model. The direction of all covariates of interest (trade agreement variables) is in line with theory and a further indication of robustness for those (see Table B.6.2 in Annex B.6). The *ICESCR* coefficients indicate that the ratification is positively associated with food security. All other control variables have the same direction of effect as in the original Fixed Effects model, with the exception of the *Conflict*, *Log(GDP)* and *Log(Food/Merchandise)* variables. The coefficients of these variables show a sign flip across models (1) to (3) within the otherwise same model specification, and have therefore to be interpreted also in light of the Dynamic Model outcomes with caution.[66]

[66]The purpose here is to analyse how BTAs and RTAs affect food insecurity in terms of direction of effect and relative magnitude (marginal effects are presented in the tables). It is not the purpose to derive interpretations on quantities of interest. The interpretation of it (one BTAs (RTAs) increases (reduces) child mortality) would not only be misleading but too me a morally wrong question to ask. Therefore, I am not presenting quantities of interest.

Table 3.4.1: Fixed Effects

	Dependent Variable: Food Insecurity		
	(1)	(2)	(3)
PTA Dummy	−10.038***		
	(1.030)		
PTA		0.752***	
		(0.243)	
RTA			−9.374***
			(0.755)
BTA			1.747***
			(0.243)
WTO	5.600***	3.513**	3.768**
	(1.533)	(1.552)	(1.487)
ICESCR	1.318*	0.460	0.394
	(0.748)	(0.760)	(0.728)
Polity	−23.236***	−27.798***	−21.149***
	(2.463)	(2.482)	(2.425)
Reg. Durability	−0.114***	−0.119***	−0.135***
	(0.036)	(0.037)	(0.035)
Conflict	0.245	−0.125	0.348
	(0.885)	(0.901)	(0.864)
Log(GDP)	−5.513***	−9.271***	−10.992***
	(2.099)	(2.196)	(2.109)
GDP Growth	−0.196***	−0.201***	−0.173***
	(0.054)	(0.055)	(0.053)
Land	−0.154**	−0.165**	−0.147**
	(0.071)	(0.073)	(0.070)
Supply	−0.171***	−0.224***	−0.182***
	(0.059)	(0.060)	(0.057)
Log(Food/Merchandise)	−1.140*	−1.081	−1.708***
	(0.646)	(0.663)	(0.637)
Rural Pop. Growth	0.908**	0.786*	0.615
	(0.410)	(0.418)	(0.400)
Water	−1.989***	−2.079***	−1.789***
	(0.072)	(0.073)	(0.073)
Sanitation	−0.330***	−0.419***	−0.440***
	(0.067)	(0.069)	(0.066)
Observations	2,325	2,325	2,325
R^2	0.634	0.620	0.651
Adjusted R^2	0.617	0.602	0.634
F Statistic	274.628***	258.657***	276.080***
Degrees of Freedom	df = 14; 2218	df = 14; 2218	df = 15; 2217
Note:			*p<0.1; **p<0.05; ***p<0.01

Table 3.4.2: Fixed Effects Robust

	Dependent Variable: Food Insecurity		
	(1)	(2)	(3)
PTA Dummy	-10.038^{***}		
	(2.815)		
PTA		0.752	
		(0.551)	
RTA			-9.374^{***}
			(2.603)
BTA			1.747^{***}
			(0.647)
WTO	5.600	3.513	3.768
	(3.876)	(4.123)	(3.696)
ICESCR	1.318	0.460	0.394
	(1.930)	(2.036)	(2.014)
Polity	-23.236^{***}	-27.798^{***}	-21.149^{***}
	(7.733)	(8.325)	(7.687)
Reg. Durability	-0.114	-0.119	-0.135^{*}
	(0.083)	(0.088)	(0.081)
Conflict	0.245	-0.125	0.348
	(1.658)	(1.571)	(1.564)
Log(GDP)	-5.513	-9.271	-10.992
	(7.367)	(7.813)	(7.356)
GDP Growth	-0.196^{**}	-0.201^{**}	-0.173^{**}
	(0.079)	(0.085)	(0.077)
Land	-0.154	-0.165	-0.147
	(0.149)	(0.156)	(0.142)
Supply	-0.171	-0.224	-0.182
	(0.150)	(0.156)	(0.149)
Log(Food/Merchandise)	-1.140	-1.081	-1.708
	(2.232)	(2.300)	(2.259)
Rural Pop. Growth	0.908	0.786	0.615
	(0.912)	(0.891)	(0.869)
Water	-1.989^{***}	-2.079^{***}	-1.789^{***}
	(0.346)	(0.359)	(0.334)
Sanitation	-0.330	-0.419	-0.440^{*}
	(0.255)	(0.284)	(0.259)

Note: *p<0.1; **p<0.05; ***p<0.01

Table 3.4.3: Arellano-Bond Dynamic Robust (Country Cluster)

	Dependent Variable: Food Insecurity		
	(1)	(2)	(3)
Lag(Food Insec.)	0.950***	0.945***	0.939***
	(0.123)	(0.015)	(0.015)
PTA Dummy	−0.584		
	(0.464)		
PTA		0.291	
		(0.202)	
RTA			−1.949***
			(0.366)
BTA			0.560***
			(0.213)
WTO	0.547	0.293	0.957
	(0.603)	(0.623)	(0.611)
ICESCR	−1.099***	−1.257***	−0.561**
	(0.313)	(0.367)	(0.219)
Polity	−4.935***	−5.284***	−3.230***
	(1.183)	(1.218)	(0.930)
Reg. Durability	−0.076***	−0.073***	−0.073***
	(0.021)	(0.023)	(0.021)
Conflict	−0.213	−0.215	−0.176
	(0.266)	(0.266)	(0.280)
Log(GDP)	3.165***	2.745***	1.421*
	(0.955)	(0.843)	(0.822)
GDP Growth	−0.032	−0.030***	−0.026***
	(0.007)	(0.007)	(0.006)
Land	−0.005	−0.005	−0.004
	(0.010)	(0.010)	(0.010)
Supply	−0.069**	−0.072**	−0.074***
	(0.034)	(0.033)	(0.028)
Log(Food/Merchandise)	0.730***	0.725***	0.397**
	(0.203)	(0.213)	(0.178)
Rural Pop. Growth	−0.072	−0.047	−0.113
	(0.119)	(0.117)	(0.116)
Water	−0.341***	−0.380***	−0.293***
	(0.074)	(0.078)	(0.071)
Sanitation	0.275***	0.243***	0.205***
	(0.056)	(0.057)	(0.050)
Constant	−0.948***	8.073	14.422
	(8.349)	(10.278)	(10.122)
Observations	2139	2139	2139
No. of Instruments	291	291	292
Wald Chi2	35184.15***	34262.81***	42128.88***
Degress of Freedom	15	15	16

Note: *z<0.1; **z<0.05; ***z<0.01

Table 3.4.4: Arellano-Bond Dynamic Robust with Lags (Country Cluster)

	Dependent Variable: Food Insecurity		
	(1)	(2)	(3)
Lag(Food Insec.)	0.953***	0.948***	0.941***
	(0.011)	(0.014)	(0.014)
PTA Dummy	−0.596		
	(0.496)		
PTA		0.250	
		(0.197)	
RTA			−1.979***
			(0.377)
BTA			0.526**
			(0.204)
WTO	0.482	0.224	0.877
	(0.572)	(0.583)	(0.602)
Lag(ICESCR)	−1.085***	−1.253***	−0.547***
	(0.282)	(0.337)	(0.203)
Polity	−4.266***	−4.642***	−2.894***
	(1.064)	(1.108)	(0.865)
Reg. Durability	−0.071***	−0.068***	−0.070***
	(0.022)	(0.021)	(0.020)
Lag(Conflict)	0.356	0.330	0.351
	(0.297)	(0.286)	(0.280)
Lag(Log(GDP))	3.063**	2.624**	1.250
	(1.369)	(1.205)	(0.826)
GDP Growth	−0.007	−0.009	−0.016
	(0.010)	(0.010)	(0.008)
Land	−0.006	−0.005	−0.005
	(0.010)	(0.010)	(0.010)
Supply	−0.051*	−0.055*	−0.059**
	(0.029)	(0.029)	(0.025)
Lag(Log(Food/Merchandise)	0.717***	0.727***	0.476***
	(0.207)	(0.216)	(0.176)
Rural Pop. Growth	0.095	0.096	0.053
	(0.103)	(0.103)	(0.111)
Water	−0.325***	−0.358***	−0.280***
	(0.070)	(0.075))	(0.069)
Lag(Sanitation)	0.273***	0.246***	0.214***
	(0.063)	(0.067)	(0.057)
Constant	−4.179	4.063	11.956
	(9.979)	(10.407)	(8.202)
Observations	2139	2139	2139
No. of Instruments	291	291	292
Wald Chi2	41027.41***	35594.60***	44541.91***
Degress of Freedom	15	15	16

Note: *z<0.1; **z<0.05; ***z<0.01

3.5 CONCLUSION

Different disciplinary and methodological lenses condition the views on whether trade is generally seen as an opportunity or threat for food security in theory (normative debate). The empirical literature provides no consensus on the impacts of trade agreements on food security. Yet, there has been some consensus that the multilateral trading system, WTO, is a managed trading regime which has restricted the policy space for food security of low and middle income countries. In light of the proliferation of PTAs, the question is whether those have regained or created policy space to contribute to better food outcomes, and whether the relatively cooperative RTAs have a different impact than the relatively competitive BTAs.

To answer the question I regressed a coherent and harmonized food security proxy, child mortality, on trade agreements variables for 93 low and middle income countries for 1990-2014, by controlling for economic, political, social and human rights variables. The results of the analysis indicate that the multilateral trading system, WTO, has restricted the policy space for food security of low and middle income countries. PTAs, which are an exception to the WTO rules, can have an initial positive impact on food security, when contrasted to none being in place. However, an increase in the number of PTAs does not necessarily lead to improved food security outcomes. BTAs, which are often negotiated among asymmetric trading partners in a competitive manner and result in a more 'competitive' design, may enhance the managed trading regime, as an increase of these is negatively associated with food security outcomes. RTAs, which often entail common policies and objectives on food security and related - and are therefore in comparison more cooperative -, contribute to better food security outcomes.

In the light of the results, it can be recommended that countries, if these have not already

exhausted their options of regional integration (number of RTAs is limited due to its definition/construction), should focus on improving an efficient implementation of the concluded RTAs (also by harmonising overlapping RTAs) rather than initiating new BTAs. Apart from the seemingly adverse effects of the latter on food security in low and middle income countries, the increasingly intervened bowl of any kind of noodles (see terms 'Spaghetti' and 'Noodle Bowl' in the literature) is creating an increasingly administrative burden and therefore a highly inefficient trading system. Moreover, given that BTAs are negotiated by bureaucrats in a competitive and power driven setting, these BTAs are not oriented on economic principles but politics.

To strengthen and support the efficient implementation of concluded but not yet efficient RTAs, more efficient trading blocks, such as the EU, should conclude BTAs (if at all) with entire trading blocks and not single out members of those for separate trade arrangements. The provisions of BTAs between high income and low income countries have to ensure that sufficient policy space is granted for countries to fulfil their right to food.

Not only BTAs but also RTAs are a distortion to the multilateral trading system in theory. Yet, while RTAs can potentially become good building blocks of the multilateral system[67] and improve regional food security, these will most likely fail to solve sensitive and crucial (market distorting) issues such as agricultural subsidies more efficiently than multilateral negotiations. Conclusively, RTAs on their own are not the first answer and a multilateral system might provide the optimum platform in theory.

The (geo-)politcial shift within the WTO sets hope for the ongoing slow to stale Doha Round to have a more balanced outcome than the previous round, if concluded. If amongst other

[67] Whether RTAs constitute stepping stones or stumbling blocks for the multilateral trading system is controversially discussed in the literature.

the Nairobi package is being lived up to, than the price-distorting direct export support to domestic farmers in mostly high income countries will be phased out, and hence, the markets will be regulated more in line with economic principles. However, WTO member states need to move beyond the mere declaratory text of the AoA and Marrakesh preamble, and concretely tackle further trade related issues which potentially hamper food security in low and middle income countries. Low and middle income countries learnt their lesson from the previous round and its implications, and hence, the only way forward for the multilateral trading system, which ideally promotes food security, is fair play.

CHAPTER 4

REGIONAL TRADE AGREEMENTS AND FOOD SECURITY ACROSS THREE REGIONS

Abstract Chapter 4

An increase in the number of regional trade agreements (RTAs), which are relatively more cooperative than bilateral trade agreements, is positively associated with food security outcomes for 93 low and middle income countries in 1990-2014. To build on these results I look into how RTAs and food security are associated across the three sub-regions of Sub-Saharan Africa, Latin America and South East Asia. A Qualitative Comparative Analysis with RTAs as the unit of analysis highlights first patterns of commonalities, but more so differences. To take into account heterogeneity across the RTAs I operationalise provisions on food security and related issues in the agreement texts. I then set up two distinct research designs and model specifications. First, to test the impact of the aggregate provisions on food security for 67 low and middle income countries which are member of at least one of the RTAs in the three sub-regions, 1990-2014, I fit a Dynamic model. Results indicate that the more food security related provisions a country has across its RTAs, the better its food security outcomes are. Second, to test whether the state of food security affects the design of a RTA, I fit a Count model, which includes an instrumental variable, on the same data. Estimates indicate that the state of food security is indeed associated with the design. The more severe the state of food insecurity within a country, the more food security related provisions the country has across its RTAs.

Keywords: Food Security / Preferential Trade Agreements / Trade Policy / Design of Trade Agreements

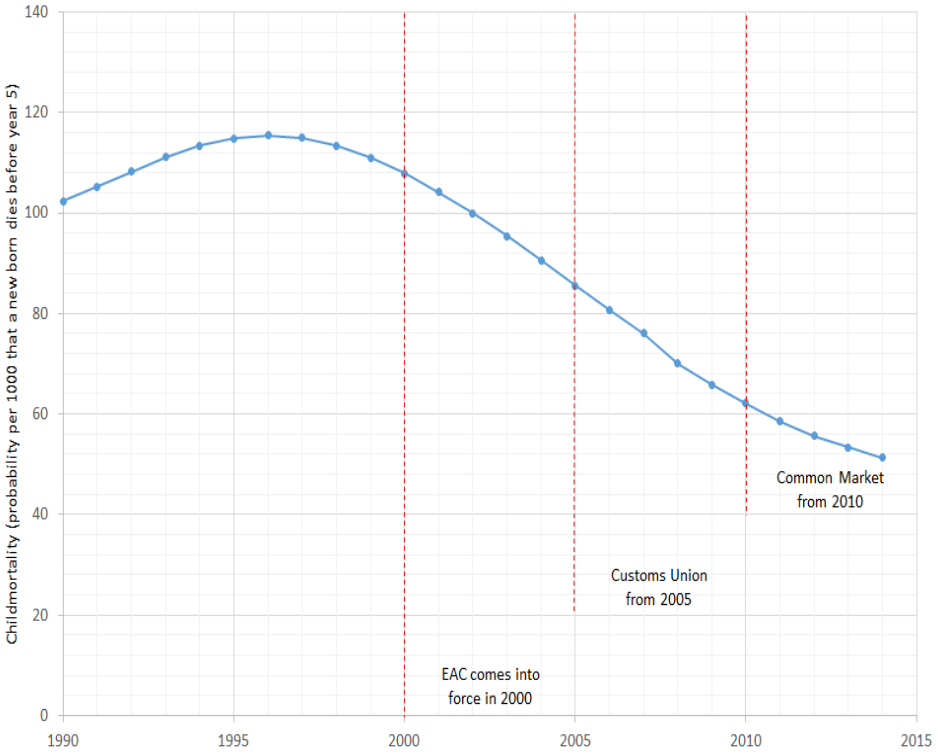
4.1 INTRODUCTION

Regional trade agreements (RTAs),[1] which are relatively cooperative, can have positive impacts on food security when compared with Bilateral Trade Agreements (BTAs), which are relatively competitive for low and middle income countries (Chapter 3). However, why are RTAs on average associated with better for food security outcomes? Moreover, does the state of food security possibly influence the design of RTAs? In other words, is it the case that the higher the acuteness of food insecurity the more likely it is for food security and food security related provisions to be included in the agreement text? And if so, do these provisions lead to better food security outcomes? To answer these questions I first look at the impact of the RTAs on food security in more detail and then I see how the state of food security possibly influences the design of RTAs across three sub-continents: Sub-Saharan Africa (hereafter Africa), Latin America (hereafter America) and South East Asia (hereafter Asia).

Kenya has been a member state of the East African Community (EAC) since its revival in 2000. The EAC increased its degree of integration by becoming a customs union in 2005 and progressed to a common market in 2010. At the same time, child mortality (in probability per 1000 that a new born dies before year 5), decreased at a much higher rate than before 2000 (since its decline in 1997). In the above context, it could then be argued that at a time when food insecurity proxied by child mortality was relatively high, Kenya agreed to negotiate a RTA which was designed in a way that it is favourable for food security; and that the impact of the EAC contributed to decreasing food insecurity.

[1] RTAs involve at least three trading partners in the same geographical (sub-)region (Josling 2009; UNU-CRIS 2008; see also Bese et al. 2009)

Figure 4.1.1: Child Mortality in Kenya 1990-2014



However, factors contributing to, or countervailing, food security outcomes are multiple and conditioned by regional history, culture, economy, infrastructure, geo-political setting and climate. As established in Chapter 3, trade agreements can be a key contributing factor. This chapter tries to find whether the association of food security and a RTA as demonstrated by the example of Kenya holds across the thee regions by controlling for some of these other factors.

Based on the notion of self-sufficiency (Chapter 3) and the classical theoretical argument of welfare gains though increased trade, regional trade cooperation and integration is often understood to enhance common food security goals. However, no consensus in the theoretical and empirical literature has been established on the impact of trade liberalisation in general and literature reviews of empirical studies show that estimates vary widely (Jean and Bureau 2016; see also Cipollina and Salvatici 2010). Jean and Bureau (2016) identify two major

problems as the potential source of variation: heterogeneity and endogeneity. Trade agreements are often either insufficiently or not at all differentiated ("generalist" vs. "specialist" approach), with the result that trade agreements' specificities are not taken into account and thereby the heterogeneity of impact is not modelled (Kohl 2014). Some scholars made a start at addressing the shortcoming of specificity by differentiating trade agreements according to different criteria such as network trade (Orefice and Rocha 2014), differences in non-tariff provisions (Kohl et al. 2016) and degree of liberalisation (Baier et al. 2015).[2] Yet, heterogeneity across agreement texts in the light of food security has not been taken into account. The criticism of endogeneity refers to the omission of variables which affect the outcome variable. In my analysis on why RTAs are associated with better for food security outcomes, I am addressing both shortcomings as follows.

First, by differentiating RTAs and BTAs some heterogeneity of trade agreements is already taken into account. In this chapter, RTAs are the focus of analysis. Therefore, I first look into the commonalities of RTAs which set them apart form BTAs, and then more importantly I analyse the extent of heterogeneity across the RTAs. Given the meanwhile comprehensive and complex nature of RTAs, I focus on potential heterogeneity in light of the research question. Accordingly, while the norm to ensure food security seems - generally - widely diffused across the continents, it is enshrined to different degrees in the RTAs of the three sub-regions. More concretely, a comparison of the agreements' texts highlights that provisions range from mere declarations to concrete policy stipulations on common approaches to food security and/or agricultural policy - ranging from agricultural policy coordination, cooperation and harmonization to common food security policies and institutions. I then analyse how these specific provisions are associated with food security.

[2] See also Jean and Bureau (2016) for a summary.

Second, as the state of food security can potentially influence how a particular norm is taken into account in trade negotiations and ultimately agreement design, the second question is whether the state of food security has an impact on the RTA design (reverse causality). Accordingly, to address the problem of endogeneity (other than the panel approach to avoid omitted variable bias), I employ an instrumental variable (natural disaster) which is exogenous to the provisions in question (outcome variable). The variation in the design of trade agreements has already been explained by several studies (as summarized by Baccini, Dür and Haftel (2015)) based on regime type, interest groups, or political stability (Düer 2007; Kucik 2012; Mansfield, Milner and Rosendorff 2002), as well as by other studies based on regional factors, such as economic interdependence and the balance of power (Haftel 2013; Johns 2013; Smith 2000). However, to test whether the state of food security influences the design of trade agreements is novel.

The chapter is structured as follows. First, I start first with the commonalities of RTAs, to differentiate them from BTAs. I subsequently highlight the heterogeneity of RTAs by comparing food security related provisions across the agreement texts; I summarise and compare the commonalities and differences in a (truth) table according to the Qualitative Comparative Analysis. This analysis sets the grounds for two hypotheses: 1) The more food security provisions a country has, the better its food security outcomes; 2) if a country is more food insecure it is more likely to include food security and related provisions. Second, after outlining the relevant research designs, I test the first hypothesis with variations of Dynamic Panel Models for 67 low and middle income countries, that are member to a RTA of the three regions over the period 1990-2014. I test the second hypothesis with a Count-model and an instrumental variable approach to control for endogeneity. In this context I argue based on previous research (Chapter 2), why child mortality is a good proxy for food (in-)security. Third, after discussing the results in light of the research design, I conclude.

4.2 Regional Trade Agreements in Africa, Asia and America

4.2.1 Common Grounds

RTAs can be distinguished from BTAs in terms of trading partners, negotiation process, the resulting design of the agreements text and the potential implications of all of these. Accordingly, RTAs have common overarching but also common regional characteristics, which I elaborate on in the following by setting it into context with the relevant theories in the literature; and relating it after to the concept of food security.

The rationale of a RTA is generally the economic and political stabilisation of the region. Trading partners have the continent-specific knowledge which sets an optimal basis to negotiate provisions which indeed facilitate the intended objectives. In other words, they establish a "dialogue and consent common rules and institutions for the conduct of their relations, and recognize their common interest in maintaining these arrangements" (Bull and Watson 1984: 1). Furthermore, relations among trading partners from the same region are very often more balanced and equitable than in the case of BTA members. As a consequence the negotiation process and its outcome, and the design of the RTA are expected to be relatively cooperative (see, e.g., Bese et al. 2009).

In more detail, the underlying theory for decision-making in regional agreements can be explained by fundamental norms and shared ideas, "plus inter-subjective beliefs, traditions, and habits" (World Trade Report 2007: 64) within a (sub-)region of in which countries often share similar cultural backgrounds (cognitivism/cognitivist approach). Common coherent goals (English school) might be another factor in the negotiation process. A classical ex-

ample is the thought that trade can promote peace, a notion developed particularly in the aftermath of World War II (WTO World Trade Report 2007).

Accordingly, while economic gain via market access remains a key factor, fundamental norms and shared ideas have shaped the process of RTA design. Furthermore, regional cohesion, policy coordination and integration (Josling 2009; Fulponi 2015) and common objectives often with the common aim to strengthen and stabilise the region economically and politically have increasingly become the rationale for RTAs. Accordingly, common examples of such common goals or objectives enshrined in provisions of RTAs include: policy coordination of the agricultural sectors and/or health and safety standards (Fulponi 2015), or (the aim of) a common agricultural policy, or the objective of enhancing food security (Josling 2009). This reflects the realists line of thought, according to who transnational norms must be first enshrined in law and policy before becoming reality (Elkins and Simmons 2005).

While food security can be a common norm and a coherent goal, it is, however, rather integral of the aim of economic prosperity and stability rather than a key driver for cooperation on its own. Yet, RTAs entail specific provisions on food security and related. These provisions declare common food security aims, whilst also setting out concrete measures on policy coordination and cooperation through joint institutions. I argue that the common intention based on shared norms and values, and context specific knowledge, shapes further policy making and action to achieve the declared common aims. Ideally, institutions are put in place that further the aim.

4.2.2 HETEROGENEITY

While the motivation for RTAs is relatively similar across the continents, their concrete designs differ. RTAs can be differentiated according to a number of different factors. One key factor is the degree of integration.

Generally, the degree of integration amongst trading partners can be distinguished in five[3] forms of integration. A Preferential Trade Area or Arrangement (PTAA) is an arrangement between two or more countries to impose lower tariffs and to reduce restrictions on imports (Gandolfo 1998; Panagariya 1999). Each member of the PTAA sets its own external tariffs and restrictions on imports from non-member countries (Gandolfo 1998). The term PTAA serves at the same time as a generic term for subsequent forms of integration. The next deeper form of integration is a Free Trade Area or Arrangement (FTA), an arrangement of two or more countries to abolish tariffs and other restrictions on their mutual trade in all goods, while retaining their individual tariffs against non-member countries (Gandolfo 1998; Chacholiades 1978). In addition to the provisions of an FTA, a Customs Union (CU) establishes a common external tariff schedule on all imports from the rest of the world (Gandolfo 1998; Chacholiades 1978). A deeper form of integration goes beyond trade relations and is called common market. Common market member countries allow themselves in addition to the provisions of the custom union "free movement of all factors of production between the member countries" (Chacholiades 1978: p. 546). An economic union is established when in addition to the common market, member countries "proceed to unify their fiscal, monetary, and socioeconomic policies" (Chacholiades 1978: p. 546).[4] If governments, after concluding negotiating details of such agreements, sign these, this so called trade agreement then con-

[3] Jovanovic (1998) differentiates six forms of economic integration. According to him the sixth, deepest level of integration, is the total economic union, which he describes as a "union with a single economic policy and a supranational government". Gathii (2011) critiques the classical five forms as being a 'Western' idea of integration.

[4] Modified text based on Kersten (2008).

stitutes binding international trade law (Article 2, Vienna Convention on the Law of Treaties). Regional arrangements often aim to achieve a higher degree of integration over time. While some RTAs start as FTAs (and have formally remained as such), other RTAs became formal CUs (or are at least aiming to become one).

Meanwhile, trade agreements have become, regardless its degree of integration, more comprehensive and encompass, beyond mere trade in goods regulations (tariffs and non-tariff barriers to trade, rules of origin), standards (sanitary and phytosanitary measures), and other areas such as intellectual property rights, foreign direct investment and services, government procurement, and dispute settlement mechanisms. Furthermore, beyond the degree of integration and areas covered, further factors of agreement design such as depth, scope, flexibility, breadth and institutionalisation (Johns and Peritz 2005) render these agreements even more heterogenous - all having different implications and effects.

The number of trading partners for each agreement (breadth), the number of agreements concluded by each trading partner including the partly overlapping agreement (network) structure of hubs and spokes[5] (ties and nodes)[6] (Pauwelyn and Alschner 2015), [7] and each country's economic, political condition, governance and infrastructure can contribute to determining the efficiency of the agreement over time (Gray and Slapin 2012, Pauwelyn and Alschner 2015; Chapter 3).

[5]The hub is the country that has several PTAs with other countries, the spokes (Kowalczyk and Wonnacott 1992), and is therefore in an advantageous position due to better access to all of its free-trading partners (Gandolfo 1998). Welfare implications for existing spoke countries depend, according to Kowalcyzk and Wonnacott (1992), on the exports of the new spoke country in relation to the exports of old spoke countries. In the case of complement export products, initial PTA partners of the hub gain. In the case of substitutes initial spoke countries might lose by a decreased degree of preference in the hub market (Kowalczyk and Wonnacott 1992).

[6]"Power law distribution also has an effect on diffusion within the system. New norms that are adopted by hub countries are more likely to spread within the network than is legal innovation undertaken by peripheral members" (Pauwelyn and Alschner 2015: 506).

[7]One prime example of overlapping membership to agreements, are the RTAs on the African continent.

In the context of food security, provisions on trade in agricultural goods, on agricultural sectors and policies are of prime relevance. Arguably, these provisions have the potential of affecting food security more directly than others.[8] For RTAs, export patterns of agricultural goods are often similar, and therefore, on the one hand, liberalisation may not result immediately in increased intra-regional trade (Josling 2009). However, on the other hand, potential members of a RTA are more likely to have similar climate and soil conditions, and therefore more similar production patterns and costs than in the case of cross-regional trade agreements. This may well make it easier to coordinate agricultural and food security via agreement provisions, and creates the opportunity to take advantage of specialisation and economies of scale (Josling 2009).

As already outlined above, whilst market access remains a key factor, the rationale of RTAs is often increasing regional cooperation, coordination and cohesion in agricultural policy and in the common objective of enhancing food security (Josling 2009). As a result, the text of RTAs entails provisions on not only the regulation of trade in agricultural goods, but also on the coordination, cooperation and/or harmonization of agricultural policies, food security aims, and in some cases, on a common agricultural policy and common food security policy. These provisions differ across RTAs, and reflect therefore some further heterogeneity of RTAs in the context of food security.

[8] See for an overview of different channels Annex.

4.2.3 By Region

The RTAs across the three sub-continents are introduced in the light of the above context to start highlighting some of the commonalities and differences.[9] These are systematised in the following sub-section in a comparative overview to set the basis for a Qualitative Comparative Analysis.

Africa

Regional integration in recent history on the African continent dates back to 1910 (with the establishment of the SACU). Since the independence of African states in the 1950s and 1960s, the idea of regional integration was further developed within different regions of the continent, driven by "the Pan-African movement of shared values, collective self-reliance in development and political independence" (UNCTAD 2009: 8). The African Economic Community (AEC) was established under the Abuja Treaty 1991, with the aim to create an African Common Market (African Capacity Building Foundation 2014) over a 34-year period (van Dijk 2011). While the AEC is still in its making, it sets out the spirit of cooperation in development beyond purely economic oriented goals (Gathii 2011). For example, in the context of food security, the Abuja Treaty sets out that parties should cooperate in developing the agricultural sectors to achieve food security (Article 46, Treaty of Abuja) and aim for a common agricultural policy at a later stage (Article 8, Abuja Treaty). This spirit of cooperation in development - particularly in the context of food security - is found in most African RTAs.[10] A further common characteristic of African RTAs is that they outline "mechanisms to minimize distributional losses by creating opportunities such as compensation for losses arising from implementation of region-wide liberalization commitments" (Gathii 2011: p. 35).[11]

[9] See Annex C.3 for further details.

[10] According to Brüntrup and Heidhues (2011) "a purely neo-liberal approach is not sufficient" in the African context "to foster food security and, consequently, development". See The African Capacity Building Foundation 2014: 33.

[11] Notably, an African Continental Free Trade Area (draft) Agreement with the aim to establish an African Union was signed among 44 African countries on 21st March 2018. As the agreement was signed after the writing up of

Likewise the multiple RTAs, with partly overlapping memberships, "were and continue to be seen as frameworks for development cooperation" (Gathii 2011: xxix) rather than an engine of economic growth only. All of the effective (i.e., still actively existing) RTAs on the continent,[12] include provisions on agriculture policies and/or food security aims.

ECOWAS

The Economic Community of West African States (ECOWAS) was founded in 1975 with the aim to set up an economic and monetary union. A revised treaty was signed in 1993. While progress on a common external tariff is being made, ECOWAS is at this stage still declared/-classified as a free trade area (Gathii 2011), currently consisting of fifteen member states - of which all are former colonies. In its revised treaty of 1993, Article 3 (Aims and Objectives) stipulates that the "aims of the Community are to promote co-operation and integration, leading to the establishment of an economic union in West Africa in order to raise the living standards of its peoples, and to maintain and enhance economic stability, foster relations-among Member States and contribute to the progress and development of the African Continent". To achieve these aims, the Community shall ensure "the harmonisation and co-ordination of national policies and the promotion of integration programmes, projects and activities, particularly in food(,) [and] agriculture" (Article 3, ECOWAS Treaty 1993). Furthermore according to Article 25 on Agricultural Development and Food Security, "Member States shall co-operate in the development of agriculture, forestry, livestock and

the text, an elaboration on the agreement is not included.

[12] In total there are more RTAs (not all of them are trade agreements in the classical sense but political cooperation agreements and similar) of which not all are effective. Gathii (2011) provides an exhaustive list: eight pillars of the African Economic Community: Arab Maghreb Union (AMU/UMA), the Community of Sahel-Saharan States (CEN-SAD), the Common Market for Eatern and Souther Africa (COMESA), the East African Community (EAC), the Economic Community of Central African States (ECCAS/CEEAC), the Economic Community of West African States (ECOWAS), the Inter-Governmental Authority of Development (IGAD), and the Southern African Development Community (SADC); other economic unions: Economic and Monetary Community of Central Africa (CEMAC), the West African Economic and Monetary Zone (UEMOA), and the West Africa Moenatary Zone (WAMZ); other groupings: Southern African Customs Union (SACU), the Mano Rvier Union (MRU), Economic Coummunity of Great Lakes Countries (CEPGL), and the Indian Ocean Commission (IOC).

fisheries in order to ensure food security". In 2005, a common agricultural policy (ECOWAP) was adopted to alleviate rural poverty and to enhance food security by supporting smallholders (van Dijk 2011).

COMESA

The Common Market for Eastern and Southern Africa (COMESA) was established in 1994 (replacing the previous Preferential Trade Area in place since 1981) with the aim to form a political and monetary union in its last stage. An FTA is in place among 19 members - of which 17 are former colonies. The 1994 establishing treaty lays out in detail how co-operation in agriculture should be implemented via different channels (Articles 131-136). Thereby, co-operation should be conducted with a view of having a common agricultural policy (Article 130), which should be ensured (Article 129). The "overall objectives of co-operation in the agricultural sector are the achievement of regional food security and rational agricultural production" (Article 129, COMESA Treaty 1994).

EAC

The East African Community (EAC) came into force in 2000. The customs union, with the aim of a political federation, has five members of which all are former colonies. Similar to the COMESA 1994 treaty, the EAC establishing treaty stipulates that the "overall objectives of co-operation in the agricultural sector are the achievement of food security and rational agricultural production" (Article 105, EAC Treaty 2000) to be achieved via harmonising national policies (also to ensure a common agricultural policy) and developing (original wording) food security (Article 105). Notably, Article 110 suggests in further detail mechanisms how to develop food security - amongst other the harmonization of nutrition and food security policies and strategies. Notably, the EAC has over time developed policy and strategy documents that address the improvement of food security and agricultural development (van

Dijk 2011; ECDPM 128c 2012): the Agricultural and Rural Development Policy (ARDP); the Agricultural and Rural Development Strategy (ARDS); (Agriculture and) Food Security Action Plan (FSAP); Regional Agricultural Trade Information Network (RATIN).

SADC

The Southern African Development Community (SADC) was formed in 1980; a Protocol on Trade was created in 1996 (Githii 2011). In 2000, the implementation of the 1996 SADC Trade Protocol commenced (start of arrangement), and was amended in 2005. In 2008, the SADC gained status of a FTA (Githii 2011). A free trade arrangement is currently in place among 13 of the 15 members of which all are former colonies. The final aim is to establish an economic union with a single currency. "The SADC treaty specifies food security, land and agriculture as areas in which member countries shall cooperate but no further information is offered with respect to agricultural trade and cooperation" (van Dijk 2011: 13). The latter was specified in the 2004 Dar-Es-Salaam Declaration on Agriculture and Food Security in the SADC Region, which is merely declaratory and external to the trade agreement. A Regional Agricultural Policy has been formally developed, yet, not been implemented.

SACU

The history of the Southern African Customs Union (SACU) dates back to 1889 (Githii 2011). The next agreement to revise the customs union was signed in 1910 and was in effect until 1969, when it was replaced by the following agreement. The trade agreement currently in place, was implemented in 2004 (last amended in 2013), and has five members, which all are former colonies and share the same official language. In contrast to the other RTAs in Sub-Sahara Africa, the text of the latter agreement only entails a provision on cooperation on agricultural policies. Namely, "Member States agree to co-operate on agricultural policies in order to ensure the co-ordinated development of the agricultural sector within the Common

Customs Area" (Article 39 SACU Agreement).

CEMAC

The precedent of the Central African Economic and Monetary Community (CEMAC) was established in 1964 by the Brazzaville Treaty and became effective in 1966. The CEMAC treaty of 1994 came into force on 24th June 1999. CEMAC has six members, which share a colonial past and the same official language. The trade agreement text itself covers merely trade in agricultural foods and does not explicitly refer food security or related in its provisions, although a Common Agricultural Strategy and Regional Food Security Program exists beyond the main trade agreement text.

WAEMU/UEMOA

The West African Economic and Monetary Zone (WAEMU) was established in 1994 (legal framework updated in 2002) and is composed of eight West African Francophone countries, which at certain times in their histories, have all been colonised. Besides covering trade in agricultural goods, the original treaty set out the objective to coordinate national sectoral policies in such areas as agriculture amongst other (Article 4(d), WAEMU Treaty 1994).

In conclusion, all RTAs texts of Sub-Saharan African countries - with the exception of CEMAC - clearly show the "strong desire for regionalism and economic integration as a way to advance Africa's food security needs and socioeconomic objectives" (The African Capacity Building Foundation 2014: 19).

America

All Latin American countries member to the here introduced RTAs gained their independence from Spain, or Portugal in the case of Brazil, in the early 19th century. As on the African

continent, a supra regional trade agreement has been negotiated with the aim to form a - yet to be implemented - sub-regional free trade area named the Union of South American Nations (UNASUR). UNASUR is mainly a merger between two sub-regional customs unions the Andean Pact and the Southern Common Market in addition to a few other countries. The two trading blocks which are potential UNASUR members, have the most progressive RTA texts in terms of food security provisions when compared with the other RTAs texts on the continent. Therefore, these will be introduced in more detail than the other four RTAs. As on the African continent some countries are member to more than one RTA, resulting in overlapping memberships.

CAN

The Andean Pact (CAN) has grown out of the dissatisfaction of smaller economies of the Latin American Free Trade Area (LAFTA) formed in 1960. The Caragena Agreement (1969) established the Andean Pact and the objective of creating a customs union. CAN membership has been changing. It has currently four members of which all are former colonies and share Spanish as their official language. The CAN Agreement stipulates under the chapeau 'Agricultural Development Programs', that "with the purpose of promoting common agricultural and agroindustrial development and attaining greater subregional food security, the Member Countries shall carry out an Agricultural and Agroindustrial Development Program, harmonize their policies, and coordinate their national plans in the sector" (Chapter VII, Article 9.9, CAN Agreement 1969). Furthermore, to fulfil these objectives, the Commission shall take steps to "create an Andean System and National Systems of Food Security", and "(J)[j]oint policies for agricultural and agroindustrial development by products or groups of products" (Chapter VII, Article 9.9, CAN Agreement 1969).

MERCOSUR

Southern Common Market (MERCOSUR) was created in 1991, but only the Treaty of Asuncion 1994 introduced a common tariff and established thereby a common market (customs union) in 1995. MERCOSUR has five member of which all are former colonies. The Treaty calls for the co-ordination of agricultural policies between the state parties; furthermore the common market involves the commitment by the members "to harmonize their legislation in the relevant areas in order to strengthen the integration process" (Article 1, MERCOSOR Treaty 1994).

CACM and CAFTA

The Central American Common Market (CACM), a customs union, was established in 1961, revised in 1993, and has currently five members. The Central America Free Trade Agreement (CAFTA), is a FTA between five members which entered into force in 2001. All member states are former colonies and share Spanish as their official language. The two RTAs mentioned in these paragraph entail provisions on the regulation of trade in agricultural in their texts but no further ones on food security and related.

NT+Colombia

The free trade agreement between the Northern Triangle (El Salvador, Guatemala and Honduras) and Colombia (NT+Colombia) came into force in 2009, and is categorised as a RTA for the purposes of this paper. All member states are former colonies and share the same official language.

NAFTA

The North American Free Trade Agreement (NAFTA) is a free trade arrangement between Mexico, Canada and the United States. As Mexico is included in the dataset, this RTA is taken

into account in the analysis, despite its rather cross-cultural and relatively competitive nature when compared to other RTAs. Unsurprisingly, the text of this RTA only covers trade in agriculture but not common aims on food security or related to food security.

In conclusion, some but not all of the RTAs of Latin American countries show some desire for regionalism and economic integration to advance food security. Conclusively, Latin American RTAs seem to be more heterogeneous in light of the food security provisions than Sub-Saharan African RTAs.

Asia

In comparison, to the RTAs on the other two sub-continents, no supra-regional integration is envisaged. Plus, countries member to the two sub-regional RTAs tend to be more heterogeneous in terms language and culture than their African and American counterparts. Furthermore, while colonisation of Asian countries ended rather recently, not all Asian RTA members were colonised.

AFTA

The Free Trade Agreement of ASEAN was established in 1993 and has currently 10 members of which 9 are former colonies. Among the AFTA members there is a focus rather on food security than on agricultural policy in general. However, in the AFTA text there are no concrete provisions as such but declarations are made in other official documents. Food security in the AFTA text is mentioned in the context of emergency situations only: "Each Member State acknowledges the value of exchanging information, particularly in an emergency situation on food safety crisis" (Article 83, AFTA Agreement 1993). Food safety is integral to the concept of food security.[13]

[13] Food safety is a compontent of the utilization pillar of the food security framework as introduced in Chapter 2.

SAFTA

The South Asian Association for Regional Cooperation (SAARC) was formed in 1985 and has currently 8 members of which 6 are former colonies. An Agriculture Centre (SAARC, previously SAIC) was established in 1988 with the mandate for information management primarily in the field of agriculture. However, only in 1995 SAARC produced its first agreement (SAPTA); and concluded a South Asian Free Trade Agreement (SAFTA) in 2006. In SAFTA, trade in agriculture is regulated but no provisions on food security or related are included.

In conclusion, the Asian RTAs are the least cooperative in terms of food security.

Cross Regional Comparison

To summarise, African and Asian RTAs have on average more members (higher degree of breadth), than Asian RTAs. This could potentially imply that the RTAs with a higher degree of breadth have larger impacts (due to economies of scale). Yet, all of the larger regional trading arrangements are primarily FTAs (with the exception of COMESA). Whether the breadth outbalances a higher degree of integration is most likely impossible to ascertain. All African countries, which are a member to the RTAs outlined, share a recent colonial past (until 20th century). All Latin American RTA member countries gained independence in the 19th century. While the colonial times of Asian countries is also rather recent, not all of the RTA members were colonised. This could imply that African countries member to the outlined RTAs share a post-colonial culture that is much more present. The latter is potentially one influencing factor for a more focused approach on stabilising the region via deeper cooperation on socio and economic matters as can be seen on the example of food security.[14]

[14]The usage of a common language is more homogeneous among the RTA member countries on the American, than on the African continent; the usage of official languages on the Asian continent differ from country to country. While sharing the same language might simplify/facilitate trade negotiation as linguistic nuances are potentially better transmitted, the language factor might not be too significant, as often English is applied as the

While all RTAs across the three continents entail meanwhile provisions on trade in agricultural goods, the inclusion and/or extent of provisions on agricultural policies and food security differ across the RTAs. Based on the comparative text analysis, African RTAs are on average the most cooperative with regards to food security, followed by American RTAs, and then Asian RTAs. The following section provides a more detailed and comparative overview on the commonalities and differences across the RTAs to identify patterns in light of outcome variable food security.

4.2.4 Qualitative Comparative Anlysis

To summarise the heterogeneity and commonalities of RTAs across the regions comparatively, I present a Qualitative Comparative Analysis truth table with RTA as the unit of analysis. In detail, Table 4.2.1, comparatively presents the degree of food security cooperation with average food security outcomes. The degree of food security cooperation consists of key trade agreement characteristics and the relevant number of provisions in the RTA concerned.

First, the degree of cooperation can be determined by the type of trade agreement. Accordingly, the type of trade agreement is coded to indicate the degree. The rationale is that a FTA is the basis of trade cooperation, and therefore given the numerical value of 0. A customs union, representing a deeper form of integration is assigned the numerical value of 1. Second, the more members are part of a RTA, the more effective are potentially the impacts of the trading arrangement due to economies of scale. Therefore, a RTA with five or less is coded 0, and with more than 5 members 1. Third, the specific provisions with implications

default if negotiating partners do not share the same official language.

for food security as already outlined above for each RTA, are summarised. Specifically, those provisions can be categorised as follows: provisions on (1) trade in agricultural goods/foods (Agricultural Coverage), (2) coordination, harmonization and/or cooperation of agricultural policies (Agricultural Policy), (3) a food security objective/aim or related (with the exception of emergency situations) (Food Security Aim), (4) common agricultural policy (Common Agricultural Policy) and (5) common food policy (Common Food Policy).

The numerical value 1 indicates where a provision is entailed in the relevant RTA, and 0 where absent. The column Aggregate Provisions (abbreviated with Aggr. Provisions) indicates the cumulative count of these provisions (the aggregate measure).[15] The next column sums up the points of aggregate measure, degree and breadth of integration. To compare the aggregate value of provisions with food security outcomes, the mean of food insecurity proxy, child mortality,[16] for each trading block in 2014 (taking into account all member states of a RTA, which are in the dataset, see Annex C.3), was compared with the regional average in 2014 and scored accordingly. The midrange (mean plus/minus 1/2 standard deviation) scores 0; above the midrange -1, and below the midrange 1 (see last column titled Food Security Outcome).[17]

While the comparative analysis does not show one coherent pattern, there are some general tendencies to observe. African RTAs entail on average more food security related provisions which can be explained by the findings of the previous table that African countries share a more recent culture of colonial past and therefore are more focused on cooperation. Furthermore, if there are more food security relevant provisions then food security outcomes seem on average to be better on the African continent. This relationship is less clear for

[15] Please note that provisions are intentionally not weighted to keep the analysis simple.

[16] See subsection 4.4.2 for reasons why child mortality is a good proxy for food security.

[17] By taking the average of 2014, the analysis is simplified to comparing the factors with a recent outcome, rather than an outcome occurring a set number of years after ratification.

Table 4.2.1: RTA Text Provisions

	Type	Breath	Agri-cultural Coverage	Agri-cultural Policy	Food Security Aim	Common Agricultu-ral Policy	Common Food Security	Aggr. Provi-sions	Sum	Food Security Outcome
Africa										
EAC	1	0	1	1	1	1	0	4	5	0
ECOWAS	0	1	1	1	1	1	0	4	5	0
CEMAC	1	1	1	0	0	0	0	1	3	-1
COMESA	0	1	1	1	1	1	0	4	5	0
SACU	1	0	1	1	0	0	0	2	3	1
SADC	0	1	1	1	1	0	0	3	4	1
WAEMU	1	1	1	1	0	1	0	3	5	-1
America										
CAN	1	0	1	1	1	1	1	5	6	-1
CAFTA	0	0	1	0	0	0	0	1	1	0
CACM	0	0	1	0	0	0	0	1	1	0
NT+C	0	0	1	1	0	0	0	2	2	0
MERCOSUR	1	0	1	1	0	1	0	3	4	0
NAFTA	0	0	1	0	0	0	0	1	1	1
Asia										
AFTA	0	1	1	0	0	0	0	1	2	0
SAFTA	0	1	1	0	0	0	0	1	2	0

Type - FTA=0, CU=1;
Breath - more than 5 member countries=1, otherwise=0;
Agricultural Coverage - provision on trade in agricultural goods/foods=1, none=0;
Agricultural Policy - provision on coordination, harmonization and/or cooperation of agricultural policies=1, none=0;
Food Security Aim - provision on food security objective/aim or related=1, none=0;
Common Agricultural Policy - provision on common agricultural policy=1, none=0;
Common Food Security (Policy) - provision on common food policy=1, none=0;
Aggr. Provisions - cumulative count of provisions;
Sum - sum of all previous points;
Food Security Outcome - realisation of food security outcome in 2014 in comparison: 0 midrange, 1 above midrange, -1 below midrange.

the American continent (NAFTA is an exceptional case - in stark contrast to other American RTAs). Here, the RTAs with the highest number of provisions are not associated with better food security outcomes but the opposite. A plausible explanation could be that, given the acute state of food insecurity more provisions on food security were included in the American RTAs to improve the situation. No conclusion can be drawn from the two cases on the Asian continent. Thereby, the truth table indicates that a two-way rationale/flow is possible. The food security related provisions can influence food security, but also the state of food security can potentially influence whether provisions are included in the trade agreement

text (see e.g., CAN). Based on these observations, I derive two hypotheses.

H1: *Food security provisions and related lead to better food security outcomes.*

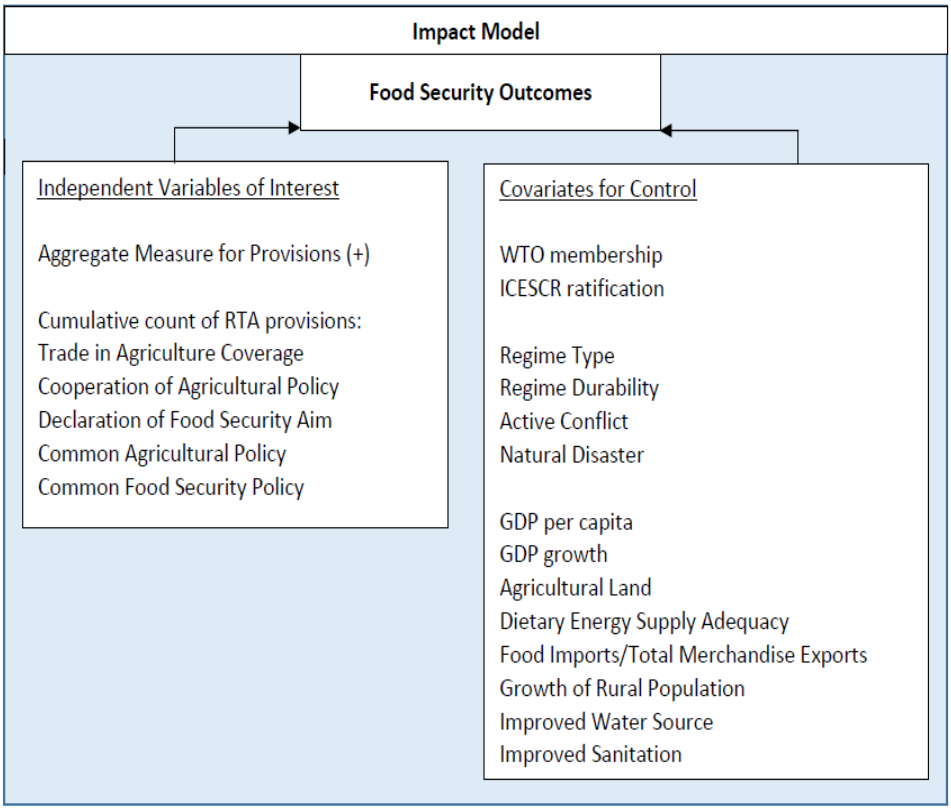
Besides the factors mentioned above which influence the decision to enter into trade negotiations, the process of negotiations and ultimately the agreement design, the (common) state of food security itself can be key in the choice of provisions. If a country/region faces a lack of food security, then there is a vital motivation for that country/region to include provisions on food security and related (enhancing food security) in the trade agreement text. Therefore, my second hypothesis is as follows.

H2: *The more acute a country's situation of food insecurity, the more food security and related provisions that country has across the RTAs of which it is a member.*

4.3 Research Design

To test the first hypothesis, I assess the impact of the specific RTA provisions on food security (Impact Model, short Model 1). Accordingly, the dependent variable is food security outcomes and the independent variables of interest is the cumulative count of the five specific provisions (as introduced above), which is expected to have a positive impact on food security.

Figure 4.3.1: Model 1 Overview



Food security outcomes represent the ultimate outcome of the state of food security as presented by the outcome-utilisation dimension of the food security framework as introduced in Chapter 2. Variables that can potentially affect food security are included in the model as controls. WTO membership can be negatively associated with food security outcomes in practice for low and middle income countries as they have been adversely affected by the WTO Agreements of 1995 (see Chapter 3). The ratification of the ICESCR can have a positive impact on food security outcomes. While it has not been assessed whether the ratification of ICESCR leads to positive economic, social and cultural human rights outcomes, the literature on the impacts of human rights treaties on civil and political human rights indicates that these treaties do have the intended effect.[18] The positive relationship between democracy (see regime type and durability) and food security has been established in the theoretical

[18]See, e.g., Fariss (2014 and forthcoming) for mainly civil and political human rights and related documents. Fariss' analysis does not include economic, social and cultural human rights.

and empirical literature, most prominently by Sen (1999) (Chapter 3).[19] For example, fragile states in Africa reported higher child mortality compared to other low-income countries that enjoyed higher political stability (African Development Bank Group 2012; see also Delbiso et al. 2017(a)). Violent conflict can be a major driver of acute food insecurity (Hendrix and Brinkman 2012).

Intuitively, natural disasters can affect food security negatively in the short and medium term. Therefore, the natural disaster variable is expected to be negatively correlated with food security (or positively correlated with food insecurity). However, for example Plümper, Quiroz and Neumayer (2017) highlight the standard narrative that individuals and governments in disaster prone areas learn to cope and are able to reduce detrimental effects and deaths in subsequent disasters.[20] In the context of food insecurity proxied with child mortality, a number of articles confirm that there is not necessarily a positive association with natural disasters. For example, De Waal et al. (2006) found that whether or not an area in Ethiopia was affected by drought during the 2002/03 drought made no difference on child mortality.[21] Delbiso et al. (2017(a)) analysed the effect of drought on child mortality in Ehtiopia for a longer period, between 2009 and 2014. Their study could also not find associations between droughs, short- or long-term, and child mortality.[22] The authors explain that this could be due to "the resilience capacity the country developed over time to deal with shocks related to drought and food shortage" (Delbiso et al. 2017(a): 5). They list four potential reasons: national policy on disaster risks and its potential consequences, productive safety net program

[19] See also Marshall and Jagger 2002, but note that there are critiques and differentiated views to this main strand.

[20] Plümper, Quiroz and Neumayer (2017) further outline under which scenarios the learning effect can be counter-productive: misplaced trust in preparedness measures and misleading lessons from past experiences. The latter is also discussed in Neumayer, Plümper and Barthel (2014), which shows that while the economic loss of an average hazard for a country with high disaster propensity might be relatively small, extreme hazards (outliers) might still lead to damage (Neumayer, Plümper and Barthel 2014). However, for the purpose of the paper the standard narrative is followed.

[21] See also Delbiso et al. 2017(a) on possible reasons for the null-findings: no differentiating of drought intensity; the one-year time elapse between the drought occurrence and time of study.

[22] Findings for wasting and drought show a similar pattern. See Delbiso et al. 2017(b).

for food insecure households in famine-prone areas highly vulnerable to climate shocks,[23] road network development which creates better access to markets for farmers and relief provision to remote villages, and the increased effectiveness of humanitarian response due to early warning systems and assessment results during emergencies.[24] The effects of different natural disasters on food food security might differ in terms of gratitude, and thus the mitigating effects across countries (see also Plümper, Quiroz and Neumayer (2017) for this and other reasons). For modelling purposes, the argument of the learning effect/mitigating effects in disaster prone areas is adopted.

The remaining cluster of covariates are all food security indicators themselves given the framework introduced in Chapter 2. Yet, these are of another dimension than the utilisation-outcome dimension (See Chapter 2 for details.). Given the framework's logic of the horizontally and vertically interdependence, these indicators are drivers for food security outcomes of the utilisation-outcome dimension, and therefore function well as controls (See also Chapter 2 and 3.). GDP per capita and economic growth rates, both structural indicators under the availability and access pillar, are positively associated with food security outcomes. Food availability is depicted via agricultural land (structural), dietary energy supply adequacy and food imports over merchandise exports (both outcome). The more agricultural land and dietary energy supply is available, the better are ultimately the food security outcomes of the utilisation-outcome dimension. The last variable, food imports over merchandise exports, not only reflects food availability but also depicts the purchasing power for food imports in terms of merchandise exports (i.e., foreign exchange reserves to pay for food imports), and therefore equally presents the access pillar. The greater the merchandise export flows of a country, the more affordable food imports become. According to the depen-

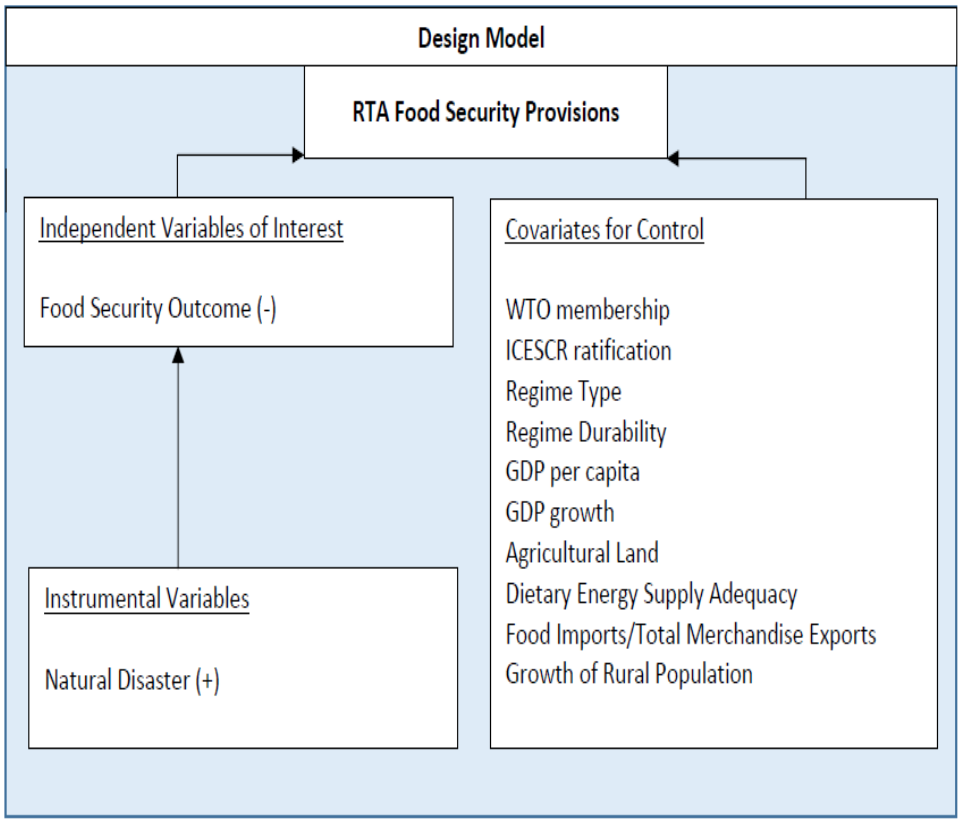
[23] See also Delbiso et al. 2017(b).

[24] See also The Federal Democratic Republic of Ethiopia: National Policy And Strategy on Disaster Risk Management (2013).

dency theory, in particular lower income countries (exporting mainly unprocessed agricultural goods) have on average a low ratio, negatively affecting food security outcomes. Given that the majority of the food insecure live in rural areas, the lower the growth of the rural population, the better average food security outcomes. The latter variable is an indicator in the access-outcome dimension. To control for other dimensions under the utilization pillar, improved sanitation and access to water sources are added, which contribute positively to food security outcomes of the utilization-outcome dimension (Chapter 3).

As already outlined, lack of food security can be a motivating factor to include the specific provisions on agriculture and food security in a RTA. Therefore, the previous model design potentially 'suffers' from endogeneity. To counter this technical problem, but also based on substantive reasons as outlined in the previous subsection and to advance the literature on the factors of RTA design, I reverse the direction of effect. To test the second hypothesis, the aggregate measure of the provisions (cumulative count) is now the variable to be explained in the Design Model (abbreviated with Model 2). Food security outcomes is the independent variable of interest. The less food security is achieved the more likely it is that the relevant provisions are contained in a RTA.

Figure 4.3.2: Model 2 Overview



To control for endogeneity I include the instrumental variable (IV): natural disaster. Natural disasters are exogenous to the here analysed RTA provisions (provisions on food security in the context of emergency, as stipulated, e.g., in AFTA, are not taken into account here).

As already outlined above, intuitively, natural disasters can affect food security negatively in the short and medium term. Yet, recent research has highlighted that mitigating/learning effects in disaster prone areas, can on average outweigh potential detrimental effects of natural disasters. Therefore in the model context, the natural disaster variable is expected to be positively correlated with food security (or negatively correlated with food insecurity).

The controls are similar to the ones in Model 1 but are selected for different theoretical reasons. If a country is a member of the WTO it is more likely to have more food security related

provisions for three potential reasons depending on the time of when the trade agreement was negotiated. First, for RTAs before the WTO Agreement on Agriculture in 1995, countries opted to include provisions on food and related to food set regulations at least within regions (missing on multilateral level). Second, for RTAs which entered into force just after 1995, countries may have wished to further specify minimum bounds and beyond set by the WTO Agreement on Agriculture within their RTAs. Third, once the implications of the interpretations of the WTO Agreement on Agriculture in praxis have become more clear for low and middle income countries, countries were motivated to intensify their cooperation on food security related matters to counterbalance the adverse affects stemming from the multilateral arrangement. If a country ratified the ICESCR it obliges itself (by international law) to fulfil economic, social and cultural human rights. Therefore, countries that ratified the ICESCR are in theory more inclined to ensure that food security is taken into account in their trade deals.

Previous research has shown that the regime type (see also Baccini, Dür and Haftel (2015); Düer 2007; Mansfield, Milner and Rosendorff 2002) matters for trade agreement design. In this particular case it can be explained based on Sen's work of 1999 (see also Sen 2000): the more democratic a country is the more will the relevant government try to ensure that basic needs, including food security, are ensured to maintain a satisfied electorate (see also Scanlan 2004 and Zidouemba 2017). The more stable a regime is, the more likely it is that long-term strategies are kept in place to ensure food security - also in its trade agreements. GDP per capita and growth can be positively associated with the aggregate measure of food security related provisions based on the rationale that ensuring food security and related provisions can be given more focus once a country progressed from (mere survival) being a low income country to a middle income country. Prior to that the focus might be on quanti-

tative growth only.[25]

The more agricultural land is available the more likely it is that the agricultural sector produces goods for exports. Accordingly, provisions on trade in agricultural goods and related are more likely to be included in the RTAs. The more dietary energy supply adequacy is guaranteed, the less there is concern for lack of food security, and provisions are less likely to be included.

The food imports over total merchandise exports variable not only reflects food availability but also depicts the purchasing power for food imports in terms of merchandise exports (i.e., foreign exchange reserves to pay for food imports). The greater the merchandise export flows of a country the more affordable food imports become. According to the dependency theory, in particular lower income countries (exporting mainly unprocessed agricultural goods) have on average a low ratio, negatively affecting food security outcomes. The more affordable food imports become for a country, the more likely it is that a country would like to specify trade in agricultural goods and related issues further.

Given that the majority suffering food insecurity live in rural areas, rural population growth indicates, that food security can potentially become more severe. Accordingly, it is more likely for a country to include more food security related provisions in its RTAs if the rural population grows.

Other potential controls could be economic interdependence and the balance of power (Haftel 2013; Johns 2013; Smith 2000) as previously discussed in the literature as factors of design.

[25] Please note that it can not be excluded that natural disaster potentially impact on food security via some of the controls- such as GDP, agricultural land, dietary energy supply adequacy. See comment also in Subsection 4.4.3.

However, as RTAs, are concluded among trading partners with a relative balanced distribution of power and interdependence, these variables are not included (these would be relevant in the context of the more competitive cross-regional trade agreements).

All of the briefly mentioned variables are further described in the context of their concrete measure in the following section.

4.4 Data, Measurement and Estimation

4.4.1 Dataset

The pooled, cross-section, time-series dataset includes variables for 67 low and middle income countries who are a member of at least one of the introduced RTAs, for 1990-2014.[26] Despite basing the case selection on data availability amongst other criteria, some observations of the covariates are still missing at random (see Annex C.5 for Pattern of Missings). Therefore, the missings (at random) in the original dataset were imputed.[27] All models are fitted based on the strongly balanced imputed dataset with 1675(=N*T=67*25) observations.

I describe the variable of interest, food (in-)security, the explanatory variables, trade agreement provisions, the covariates for control and the instrumental variables in the following, before elaborating on the structure of the dataset and the estimation method in more detail. The descriptive statistics for all variables, of which all numerical values were last updated 25th October 2015, are reported in Annex B.4 (original dataset with MAR) and Annex C.5 (imputed dataset).

[26] After filtering for low and middle income RTA member countries the process of case selection is based first on data availability; second, whether countries have missings at random (otherwise deletion); third, outliers are not included.

[27] Imputations were run 100 times by semiparametrically estimating the parameters of a Gaussian copula with R package sbgcop (Hoff 2015). The means of 100 imputations for each variable constitute the dataset. This method was chosen over other methods and R packages for reasons given in Hollenbach et al. 2017.

4.4.2 VARIABLES AND MEASUREMENT

Food (In-)Security[28]

In Chapter 2 I highlighted the complexity of the concept of food security and introduced a framework which facilitates the identification of relevant food security variables. According to this framework, utilisation-outcome variables are the variables measuring the actual realisation of food (in-)security. Child mortality is one of the identified outcome-utilization variables. The indicator child mortality reflects apart from individual outcomes under the utilization pillar complementary factors on the macro level (some of the control variables). Furthermore, child mortality is highly correlated with other food insecurity proxies of the utilization-outcome dimension such as anthropometric and biochemical indicators (see Chapter 2). Even though high correlation might not suggest interchangeability as Caspers and Tufis (2003) have shown in the context of democracy measures, in this context child mortality might reflect the other utilization-outcome variables well. For instance, child deaths are found to be attributable to undernutrition in low and middle income countries (Black et al. 2013).[29] Based on these reasons (besides data availability) the dependent variable of interest in Model 1 and the key independent variable in Model 2, food security are proxied with child mortality as, for example, done in Olper et al. (2014).[30]

Child mortality is the mortality rate among children and describes more precisely the probability per 1,000 that a newborn dies before year five (0-4 years) (Kersten PhD Paper I). Accordingly, the dependent variable depicts not food security but *Food Insecurity* and therefore all effects as listed in Figure 4.3.1 (Model 1) and the effect of the key independent and instrumental variable in Figure 4.3.2 (Model 2) are reversed.

[28] Sourced from World Bank. Data provided by UN Inter-agency Group for Child Mortality Estimation (UNICEF, WHO, World Bank, UN DESA Population Division).

[29] See also Campbell et al. 2009, who have shown that higher household food insecurity in Indonesia is associated with higher child mortality.

[30] Child mortality, or other anthropometric variables, are referred to in the literature as a food security proxy. See, e.g., Olper et al. (2014) and McCorriston et al. (2013).

RTA Provisions[31]

The key independent variables in Model 1 and the one outcome variable in Model 2 is a variable that operationalises the specific provisions of RTAs across the three regions as introduced above. This variable is constructed by five variables. In detail, the five disaggregated variables *Trade in Agricultural Coverage*, *Cooperation of Agricultural Policy*, *Declaration of Food Security Aim*, *Common Agricultural Policy*, and *Common Food Security Policy* depict each a different provision. The variable *Trade in Agricultural Coverage* cumulatively counts the number of RTAs that cover trade in agricultural goods for each country. Similarly, the variable *Cooperation of Agricultural Policy* cumulatively counts the number of provisions a country has on the coordination, cooperation and harmonization of agricultural policy. The variable *Declaration of Food Security Aim* cumulatively counts provisions on whether food security is at least declared (if not also concretely mentioned as a key objective). The variable *Common Agricultural Policy* and *Common Food Security Policy* each cumulatively count provisions which concretely outline the aim of a common policy. The key dependent variable of interest *Aggregate Measure for Provisions* sums up the values of the five disaggregated variables for each country and year.

For a presentation of the bivariate relationship between the dependent and key independent variables please refer to Figure C.4.2 (correlation matrix) and C.4.3 (scatter plots) in Annex C.4.

WTO Membership[32]

The WTO membership dummy variable, *WTO*, indicates whether a country is a member to the WTO (value=1) or not (value=0) in a given year. It means that the value of the WTO vari-

[31] Own coding.
[32] Own coding based on WTO membership list.

able can change over time for a country (see also Chapter 3).

ICESCR Ratification[33]

The ICESCR ratification ordinal variable, *ICESCR* denotes whether a country ratified (value=2) or signed (value=1) the UN Convention on Economic, Social and Cultural Rights, or none of the aforementioned. The reason to chose an ordinal rather than a dummy variable (ratified or not) is twofold. First, in principle, a signature subject to ratification does express the willingness of the signatory state to ratify and it creates an obligation to refrain from acts that would defeat the object and purpose of the treaty (Article 10 and 19, Vienna Convention on the Law of Treaties). Ratification creates the obligation to be bound to the treaty (Article 2(b) and 14, Vienna Convention on the Law of Treaties), which in principle can therefore have a stronger positive impact on the right to food. The second reason is methodological. An ordinary variable allows potentially for more within variation than a dummy variable (see also Chapter 3).

Regime Type and Duration[34]

Polity IV is the rescaled Polity IV variable depicting regime type (strong autocracy to strong democracy) on a scale 0 to 1 (from original scale -10 to 10), ranging from strongly autocratic to strongly democratic.[35].

The variable regime durability, *Reg. Durability*, describes the number of years since the most recent regime change (Polity IV Project: Dataset Users' Manual v2016: 17) (see also Chpater 3).

[33] Own coding based on UN Treaty Collection List.
[34] Source: Polity IV Project.
[35] See (Polity IV Project: Dataset Users' Manual v2016: 16-17

Armed Conflicts[36]

The variable *Conflict* denotes the number of active armed conflicts (internal and internationalized internal) in a country for a given year (see also Chpater 3).[37]

Natural Disasters[38]

The variable *Natural Disaster* depicts the count of the occurrences of different types of natural disasters within a year and country. If no count is given for a year and country, it is assumed that no disasters occurred. The types of natural disasters are: drought, earthquake epidemic, extreme temperature, flood, impact, insect infestation, landslide, mass movement (dry), storm, volcanic activity and wildfire.

Controls derived from the Food Security Framework[39]

The variable *Log(GDP)* is the logarithm of real (constant 2011 international dollar) GDP per capita based on purchasing power parity (PPP) for better cross country comparison.[40] GDP per capita is logarithmized, not primarily to control for skewness of the distribution, but to allow for similar effects of increments along minimum to maximum values. GDP growth (in percentage) is the annual GDP (in local currency) growth rate per capita (see also Chapter 3).

The variable agricultural *Land* (sourced from WB but originally from FAO) is the share of land area that is arable (in percentage).

Dietary energy supply adequacy[41] is the energy supply (calories for food consumption) for

[36] Source: UCDP Monadic Conflict Onset and Incidence Dataset (Harbom and Wallensteen 2012; and Gleditsch, Wallensteen, Eriksson, Sollenberg, and Strand 2002).

[37] Readme file for the UCDP Monadic Conflict Onset and Incidence Dataset.

[38] Data were provided by Alejandro Quiroz Flores; see also Flores and Smith (2012). The data applied here were prepared by Alejandro Quiroz Flores. The source of raw data is EM-DAT The International Disaster Database.

[39] All sourced from World Bank or FAO; original data provided by different agencies.

[40] Source: World Bank Development Indicators.

[41] Source: FAO.

a country divided by the average dietary energy requirement of the population (percentage, 3-year average). Accordingly, rather than just providing information on the quantity, it indicates whether the supply is sufficient in relation to the population (see also Chapter 3).

The variable food imports over total merchandise exports[42] (percent, 3-year average) has comparatively high values for particularly lower income countries, given that these have relatively low merchandise export flows. Therefore, to adjust the high values to a lower scale, and to take account for the skewed distribution (lesser reason), the logarithm is taken of this variable, and named *Log(Food/Merchandise)* (see also Chapter 3).

The variable *Rural Population Growth* (annual percent)[43] is the growth rate of the share of the population living in rural areas as defined by national statistical offices and calculated as the difference between total population and urban population (see also Chapter 3).

Improved sanitation facilities[44] depicts the percent of population using improved sanitation facilities; and presented by variable *Sanitation* (see also Chapter 3). The variable improved *Water* source[45] refers to the percentage of population with access to an improved drinking water source. The distribution of the variable is skewed. However, to keep the variable on the percentage scale as the rest of the 'food-security' covariates for control and to make it more comparable to the related variable sanitation, the values of the variable are not transformed (see also Chapter 3).

[42] Source: FAO.
[43] World Bank estimates based on UN World Urbanization Project.
[44] Sourced from World Bank. Original source is WHO/UNICEF Joint Monitoring Program for Water Supply and Sanitation.
[45] Sourced from World Bank. Original source is WHO/UNICEF Joint Monitoring Program for Water Supply and Sanitation.

4.4.3 Estimation Model and Method

For Model 1, I fit first a Fixed Effects model on the strongly balanced cross-country time series data to control for further unobserved country-specific effects on food security.[46] The linear fixed effects model for country i=1,...,67 and year t=1,...,25 is presented in (4.4.1). The difference to (3.3.1) in Chapter 3, are the key independent variables. In Chapter 3, the key independent variables were *PTA*, *RTA* and *BTA*. Here, the key independent variable is the *Aggregate Measure for Provisions* variable.

$$\begin{aligned} FIS_{it} = & \alpha_i + \gamma_1 ALLPROV_{it} \\ & + \beta_1 WTO_{it} + \beta_2 ICESCR_{it} + \beta_3 POLITY_{it} + \beta_4 RDUR_{it} \\ & + \beta_5 CONFLICT_{it} + + \beta_6 NATDISASTER_{it} \\ & + \beta_7 Log(GDP)_{it} + \beta_8 Log(GDPGR)_{it} + \beta_9 LAND_{it} + \beta_{10} SUPPLY_{it} \\ & + \beta_{11} FOMEit + \beta_{12} RPOPGR_{it} + \beta_{13} SANITATION_{it} + \beta_{14} WATER_{it} + u_{it} \end{aligned} \tag{4.4.1}$$

FIS_{it} is the dependent variable food insecurity; α_i is the unobserved individual country effect; $ALLPROV_{it}$ is the main independent variable, which is a cumulative count variable aggregating all five specific provisions; γ_1 is the slope parameter for $ALLPROV_{it}$; WTO_{it} is a dummy on WTO membership; $ICESCR_{it}$ is the ICESCR ratification variable; $POLITY_{it}$ is the Polity IV variable; $RDUR_{it}$ is the regime durability variable; $CONFLICT_{it}$ is the conflict variable; $NATDISASTER_{it}$ is the natural disaster variable; $Log(GDP)_{it}$ is the GDP per capita variable; $GDPGR_{it}$ is the GDP per capita growth variable; $LAND_{it}$ is the agricultural land variable; $SUPPLY_{it}$ is the dietary energy supply variable; $FOME_{it}$ is the values of food imports divided by values of merchandise exports variable; $RPOPGR_{it}$ is the rural population growth variable; $SANITATION_{it}$ is the improved sanitation variable; $WATER_{it}$ is the

[46] Hausman test statistically confirms that Fixed Effects model is to be preferred over Random Effects model. Moreover, Fixed Effects model is the only option out of the two, as the moment/strict exogeneity condition most likely does not hold.

improved water source variable; β_1 to β_{14} are the relevant slope parameters; u_{it} is the error term.

After controlling for unit heterogeneity in the Fixed Effects model estimated via Ordinary Least Squares (OLS) (results are presented under the following section in Table 4.4.1, column *FE (1)*), there is still heteroskedasticity (Breusch-Pagan test) and also autcorrelation (Breusch-Gorfrey, Wooldrdige and Durbin-Watson test) in the errors. Therefore, to correct for heteroskedasticity and serial correlation I employ a robust covariance matrix according to the White (1980, 1984)[47] [48] and the Arellano (1987) method, clustered over countries. Results for robust standard errors are presented under the following section in Table 4.4.1 under column *Robust FE (2)*.

Furthermore, to correct alternatively for violations of the Gauss-Markov assumption and to generally specify an alternative model for robustness [49], I fit an Arellano-Bond dynamic model (estimated via General Method of Moments (GMM)) with adjusted standard errors for clustering on country (one-step, differences as instruments); see Table 4.4.2, column (1). There is no statistical indication for autcorrelation to be remaining (Arellano-Bond test). Given that the autoregressive process is not persistent, there is indication for the differences to be sufficiently strong instruments. Nevertheless, I fit additionally a model with additional moment conditions, namely the lagged difference of the dependent variable (level equation), according to Arellano-Bover-Blundell-Bond, also to highlight robustness in results (see Table 4.4.2, column (2)). Also, in the latter case, there is no statistical indication for the errors (first-differences) to correlate. I modify the dynamic models, in a third specification, by

[47] Based on Eicker 1963.

[48] Here, adjustments for small/finite samples according to MacKinnon and White (1985) amongst other did not lead to significant differences in the standard errors. Therefore, the simple weighting for the variance-covariance matrix is applied.

[49] Other reasons are that the robust standard errors more than double in the Fixed Effects model. This can potentially be an indication for a misspecified model according to King an Roberts (2015).

lagging the *Conflict* and *Natural Disaster* variables as presented in Table 4.4.3. The country specific constants take into account the region specific heterogeneity well. Additional Regional dummies are multicollinear and are therefore not specified.

One major problem with Model 1 is endogeneity between the dependent and key independent variable. The design of the trade agreement has potentially an effect on food insecurity but also vice versa. Therefore, and also in context of the research question on driving factors of design, the key independent variable food security in Model 1, is set to be the variable to be explained in Model 2. To control for endogeneity, I employ an instrumental variable (IV), which influences potentially the state of food insecurity but not the here examined trade agreement provisions. One potential instrumental variable is the *Conflict Variable*. Yet, as the state of peace can influence whether or not there is planned cooperation; and if, then the presence/absence of conflict can still influence the negotiation process. Furthermore, a country with ongoing and and severe conflict is less likely to implement relevant provisions effectively. Therefore, the *Conflict Variable* is not a strong IV on substantive grounds. In contrast, it is very unlikely that the variable *Natural Disaster* influences the design of the relevant provisions (with the exception of droughts), but can potentially immediately impact the state of food security. Therefore, the variable *Natural Disaster* is a more sound IV on substantive grounds (validity).

On statistical grounds, the *Natural Disaster* variable is the more ideal IV given that it correlates (Pearson) more strongly with the key independent variable *Food Insecurity* (r=-0.23) than with the dependent variable *Aggregate Provision* (r=-0.19) (strength). The variable *Conflict* has almost no correlation with the variable *Food Insecurity* However, *Natural Disaster* is only a weak instrument. Given that the correlation with *Food Insecurity* is rather weak, standard errors are expected to be large (inefficiency). Plus, given this weak correlation, the

correlation with *Aggregate Provision* is too high. Moreover, the exclusion restriction does very likely not hold, as natural disaster potentially affects food security via some of the controls such as the GDP variables, agricultural land and dietary energy supply.

To take into consideration that the dependent variable of Model 2, *Aggregate Provision*, is a count variable I fit a Poisson model with multiplicative error term on the data. Model 2 is estimated via the General Method of Moments (minimizing sample moment condition according to Gauss-Newton). Furthermore, to take account for endogeneity of the key independent variable, I apply a control function estimator (auxiliary parameter). I first introduce the generic model before applying it to the here relevant context.

The multiplicative model can be expressed as the dependent variable y_i being the function of the key independent and endogenous variable $\mathbf{y}_{2,1}$, the exogenous covariates $\mathbf{x}_i$ and the error $\epsilon_i = \rho v_i + c_i$. $\mathbf{z}$ is the instrumental variable, and the vector $\tilde{\mathbf{z}}$ is $(\mathbf{x'}_i, \mathbf{z'}_i)$. To control for endogeneity the control-function estimator augments the original multiplicative model with an estimated term from a first-stage estimation that controls for the endogeneity of $y_{2,i}$ in the second stage. In more detail, the first step (auxiliary function), which theoretically constitute parts of the error term in step two ($\epsilon_i = \rho v_i + c_i$, with c_i being the errors), functions as an additional covariate which controls for endogeneity of the key independent variable. The relevant coefficient ρ indicates the strength of endogeneity. The augmented model a specific form of the exponential conditional mean model is specified as follows (second step).[50]

[50] For further details on the method see Wooldridge 2010, Newey 1984, Mullahy 1997; and STATA help file ivpoisson.

$$y_i = exp(\mathbf{x'}_i\beta_1 + \mathbf{y'}_{2,i}\beta_2 + \mathbf{v'}_i\rho + c_i) \tag{4.4.2}$$

Where $\mathbf{y}_{2,i}$ is the auxiliary function estimated in the first step.

$$\mathbf{y}_{2,i} = \mathbf{B}\tilde{\mathbf{z}}_i + \mathbf{v}_i \tag{4.4.3}$$

I reiterate now the model with the relevant variables. In a first stage, the relationship between the endogenous covariate, the key independent variable *Childmortatlity*, and the instrument *Natural Disaster* plus the other exogenous covariates is estimated (see first equation of Model 2 below). The residuals of the first step, which theoretically constitute parts of the error term in step 2 ($\epsilon_{it} = \rho\widehat{v_{it}} + c_{it}$, with c_{it} being the errors), are employed as an additional covariate which controls together with the coefficient ρ (strength of endogeneity), for the endogeneity of *Childmortatlity*. The second equation shows the Poisson model with multiplicative error term with the dependent variable *Aggregate Provision*, the exogenous covariates, and the control function estimator ($\rho\widehat{v_{it}}$). In this way endogeneity is accounted for, yet, heterogeneity is a remaining issue. To control for heterogeneity to some degree, the errors are clustered by country.[51]

[51] Clustering the errors by region, results in no significant key variables and are not presented but further commented on in the results section.

Model 2

$$
\begin{aligned}
FIS_{it} = & \alpha_{it} + \gamma_1 NATDISASTER_{it} \\
& + \beta_1 WTO_{it} + \beta_2 ICESCR_{it} + \beta_3 POLITY_{it} + \beta_4 RDUR_{it} + \beta_5 CONFLICT_{it} \\
& + \beta_6 Log(GDP)_{it} + \beta_7 Log(GDPGR)_{it} + \beta_8 LAND_{it} + \beta_9 SUPPLY_{it} \\
& + \beta_{10} FOMEit + \beta_{11} RPOPGR_{it} + v_{it} \\
ALLPROV_{it} = & exp(\alpha_{it} + \gamma_2 FIS_{it} \\
& + \beta_{12} WTO_{it} + \beta_{13} ICESCR_{it} + \beta_{14} POLITY_{it} + \beta_{15} RDUR_{it} + \beta_{16} CONFLICT_{it} \\
& + \beta_{17} Log(GDP)_{it} + \beta_{18} Log(GDPGR)_{it} + \beta_{19} LAND_{it} + \beta_{20} SUPPLY_{it} \\
& + \beta_{21} FOMEit + \beta_{22} RPOPGR_{it} + \rho_1 \widehat{v_{it}} + c_{it}) \qquad (4.4.4)
\end{aligned}
$$

FIS_{it} is the dependent variable food insecurity; α_{it} is the individual constant; $NATDISASTER_{it}$ is the natural disaster variable; WTO_{it} is a dummy on WTO membership; $ICESCR_{it}$ is the ICESCR ratification variable; $POLITY_{it}$ is the Polity IV variable; $RDUR_{it}$ is the regime durability variable; $CONFLICT_{it}$ is the conflict variable; $NATDISASTER_{it}$ is the natural disaster variable; $Log(GDP)_{it}$ is the GDP per capita variable; $GDPGR_{it}$ is the GDP per capita growth variable; $LAND_{it}$ is the agricultural land variable; $SUPPLY_{it}$ is the dietary energy supply variable; $FOME_{it}$ is the values of food imports divided by values of merchandise exports variable; $RPOPGR_{it}$ is the rural population growth variable; β_1 to β_{11} are the relevant slope parameters; v_{it} is the error term; $ALLPROV_{it}$ is a cumulative count variable aggregating all five specific provisions; γ_2 is the slope parameter for $ALLPROV_{it}$; β_{12} to β_{22} are the relevant slope parameters; $\widehat{v_{it}}$ are the residuals of the first equation; ρ_1 is the slope parameter of the residuals (strength of endogeneity); $\rho\widehat{v_{it}} + c_{it}$ is the entire error term with c_{it} being the errors of the second equation.

4.4.4 RESULTS

Estimates of Model 1 for the Fixed Effects model with and without an adjusted variance-covariance matrix for robust standard errors, are presented in Table 4.4.1. Estimates of Model 1 for the Dynamic model are shown in Table 4.4.2 and 4.4.3.

Model 1 controls for heterogeneity, but not, as outlined above, for endogeneity. Therefore, results are not reliable as such (due to bias/inconsistency) but are briefly commented on. Across the results (OLS and GMM) of Model 1, the key independent variable *Aggregate Provision*, has the expected direction of effect: The more provisions related to food security a country has committed to in its trade agreement(s), the lower the state of food insecurity (significance across the variations of estimations). The estimated coefficients of the *WTO* variable show the expected direction of effect across the results (significant for Arellano-Bond-Blundell-Bover model). These results confirm previous findings in Chapter 3, which indicate that a membership of the WTO has sofar been to the detriment of low and middle income countries in terms of food security. Coefficients of the *ICESCR* variable have the expected direction of effect for the GMM models (significant for Arellano-Bond). The ratification of the CESCR is positively associated with food security outcomes.

The more democratic (*Polity*) (coefficients are significant except for FE robust) and the more politically stable a country is (*Regime Durability* coefficients are significant for most GMM results) the higher its food security. While the coefficients of the *Conflict* variable show the expected direction of effect only for the two lastly specified models (GMM with lags), the estimates for the *Natural Disaster* variable have the expected negative direction of effect for the dynamic models with and without lags.[52] Coefficients of *Log GDP* (exception is Arellano-Bond-Blundell-Bover specification) and *GDP Growth* are in line with theory and accordingly

[52] Including a third lag of the *Natural Disaster* variable leads to similar estimates.

positively associated with food security. The more *Land* and dietary energy *Supply* is available the better is food security realised (exceptions are Arrelano-Bond and Arellano-Bond-Blundell-Bover specifications). The direction of effect for the variables *Food/Merchandise* and *Rural Population Growth* are in line with theory for the GMM models, but not for the OLS models. The *Water* variable is - as expected - negatively associated with child mortality, but the *Sanitation* variable shows the expected direction of effect only for the OLS models. Accordingly, while the key variables are robust, not all control variables are across the models.

In the first exponential mean model specification for Model 2 all variables are included, as presented in the first column of Table 4.3.1. All coefficients show the expected direction of effect, and the auxiliary coefficient rho, ρ (strength of endogeneity), is significantly different from 0 at the 5 percent level. The latter indicates, that *Childmortality* is significantly endogeneous in this specification.

However, when further improving the specification of the model by taking out insignificant variables such as *Land*, *Supply* and *Rural Population* (an exception is made for the *WTO* variable, which is kept in the model for substantive reasons), the strength of endogeneity slightly decreases, and the coefficient is now significantly different from 0 - a the slightly above 5 percent level (p=0.05), see second column of Table 4.4.4.

To take into account, that *Natural Disasters* might have effects on the *Food Insecurity* proxy in the medium term (also to take the learning/mediating effect better into account), I lag the instrumental variable by two years, see Table 4.3.2. The results confirm, that the models with a lag fit the data with more precision (p-values for *Childmortality* and *Natural Disaster* become smaller).

Table 4.4.1: Model 1: OLS Fixed Effects

	Dependent Variable: Food Insecurity	
	FE	*Robust FE*
AggregateProvision	−3.231***	−3.231***
	(0.297)	(1.080)
WTO	4.009**	4.009
	(1.929)	(4.771)
ICESCR	2.219**	2.219
	(0.932)	(2.648)
Polity	−10.353***	−10.353
	(2.785)	(9.366)
Regime Durability	−0.044	−0.044
	(0.044)	(0.097)
Conflict	−0.596	−0.596
	(1.040)	(1.863)
Natural Disaster	0.118	0.118
	(0.199)	(0.194)
Log(GDP)	−22.768***	−22.768**
	(2.969)	(11.061)
GDP Growth	−0.275***	−0.275*
	(0.082)	(0.161)
Land	−0.031	−0.031
	(0.096)	(0.200)
Supply	−0.314***	−0.314
	(0.088)	(0.258)
Log(Food/Merchandise)	−4.473***	−4.473
	(0.806)	(2.901)
Rural Population Growth	−0.732	−0.732
	(0.532)	(1.319)
Water	−2.070***	−2.070***
	(0.095)	(0.400)
Sanitation	0.039	0.039
	(0.089)	(0.261)
Observations	1,675	
R^2	0.678	
Adjusted R^2	0.662	
F Statistic	223.511*** (df = 15; 1593)	
Note:		*p,z<0.1; **p,z<0.05; ***p,z<0.01

Table 4.4.2: Model 1: GMM Dynamic Models

	Dependent Variable: Food Insecurity	
	Arellano-Bond	*+Blundell-Bover*
Lag(Childmortatility)	0.938***	0.933***
	(0.014)	(0.016)
Aggregate Provision	−0.561***	−0.480***
	(0.158)	(0.161)
WTO	1.185	1.608**
	(0.827)	(0.797)
ICESCR	−0.891**	−0.400
	(0.383)	(0.395)
Polity	−2.828**	−4.282***
	(1.209)	(1.497)
Regime Durability	−0.064***	−0.080***
	(0.022)	(0.029)
Conflict	−0.415	−0.751**
	(0.293)	(0.359)
Natural Disaster	−0.008	−0.044
	(0.032)	(0.047)
Log(GDP)	−0.721	1.985*
	(2.255)	(1.160)
GDP Growth	−0.003	−0.037*
	(0.015)	(0.020)
Land	−0.013	0.060**
	(0.011)	(0.027)
Supply	0.023	0.056
	(0.044)	(0.046)
Log(Food/Merchandise)	0.812***	0.731**
	(0.273)	(0.364)
Rural Population Growth	0.010	0.141
	(0.221)	(0.223)
Water	−0.399***	−0.366***
	(0.081)	(0.092)
Sanitation	0.393***	0.193***
	(0.091)	(0.067)
Observations	1541	1608
Wald chi2 Statistic	29324.46*** (df = 16)	51858.78*** (df = 16)
Note:		*p,z<0.1; **p,z<0.05; ***p,z<0.01

Table 4.4.3: Model 1: GMM Dynamic Models with Lags of Covariates

	Dependent Variable: Food Insecurity	
	Arellano-Bond	*+Blundell-Bover*
Lag1(Childmortatility)	0.933***	0.927***
	(0.015)	(0.014)
Aggregate Provision	−0.519***	−0.409***
	(0.147)	(0.162)
WTO	1.117	1.710*
	(0.891)	(0.894)
ICESCR	−1.471**	−0.620
	(0.583)	(0.586)
Polity	−3.002**	−4.596***
	(1.348)	(1.714)
Regime Durability	−0.078***	−0.099***
	(0.026)	(0.034)
Lag1(Conflict)	0.340	0.019
	(0.301)	(0.295)
Lag2(Natural Disaster)	−0.109***	−0.149***
	(0.038)	(0.050)
Log(GDP)	−1.466	1.809
	(2.666)	(1.193)
GDP Growth	−0.001	−0.040*
	(0.015)	(0.022)
Land	−0.017	0.059**
	(0.012)	(0.029)
Supply	0.025	0.075
	(0.078)	(0.070)
Log(Food/Merchandise)	0.774***	0.698*
	(0.273)	(0.370)
Rural Population Growth	0.308	0.635**
	(0.287)	(0.301)
Water	−0.413***	−0.387***
	(0.071)	(0.081)
Sanitation	0.457***	0.217***
	(0.095)	(0.077)
Observations	1474	1541
Wald chi2 Statistic	28523.11*** (df = 16)	52838.56*** (df = 16)
Note:		*p,z<0.1; **p,z<0.05; ***p,z<0.01

The instrumental variable *Natural Disaster*, whether lagged or not, is negatively associated with the *Food Insecurity* proxy according to the above described model results. This was expected based on the descriptive statistics and the findings in the literature (see Plümper, Quiroz and Neumayer 2017).[53] Conclusively, it can be confirmed that there is statistical indication for natural disaster mediating programs and similar to be effective.

The higher food insecurity, the more food security provisions a country has enshrined in its RTAs. WTO membership further influences this positively (however, direction of effect is not robust across the models). Also the ratification of the ICESCR has a positive impact on including the food security related provisions. The more democratic a country is and the more stable the regime is, the higher the number of these trade provisions. GDP per capita and growth are also positively associated with the provision variable. Estimates for the agricultural *Land*, *Supply*, and *Rural Population Growth* variables are not significantly different from zero, and furthermore have sign flips across the models (same for the *WTO* variable). Conclusively, the results for those variables are not reliable, and are therefore not interpreted here.

As an alternative to clustering standard errors by country, I clustered these by region. However, the key dependent variable *Childmortality* is not further significant and no lag of the natural disaster variable then fits the data well. These results indicate that RTAs within regions are heterogenous.[54] This complements findings based on the qualitative analysis as outlined in the conclusion.[55]

[53] There is a positive association when the variables *Childmortality* and *Natural Disaster* are log transformed and squaring after. Yet, overall the model then seems not to fit data well and there is no statistical indication for endogeneity - which was then erroneously accounted for.

[54] A RTA variable to capture variation on the RTA level, is due to overlapping membership to RTAs not feasible as such. The optimal approach take on here is to take heterogeneity into account via the provisions variable.

[55] In addition, I added year dummies, which did not change the results substantively and are therefore not presented here. Furthermore, I fitted an Arellano-Bond-Blundell-Bover (not taking into account that dependent

The results confirm both hypotheses. The higher food insecurity is (proxied with child mortality) the more likely it is for countries to take into account food security provisions in their RTAs. The more food security provisions a country has stipulated in its RTAs the better are food security outcomes.

variable is a count variable) and a Poisson Fixed Effects models which are misspecified and also not further presented.

Table 4.4.4: Model 2: Poisson Model with Multiplicative Error Term and Instrumental Variable Control Function (Country Cluster)

	Dependent Variable: Aggregate Provision	
	Full Model	*Reduced Model*
Childmortality	0.039**	0.042**
	(0.020)	(0.021)
WTO	0.072	0.097
	(0.365)	(0.380)
ICESCR	0.606***	0.603***
	(0.201)	(0.211)
Polity	1.775**	1.710**
	(0.769)	(0.830)
Regime Durability	0.018**	0.018**
	(0.008)	(0.008)
Log(GDP)	1.722*	1.791*
	(0.964)	(1.060)
GDP Growth	0.042**	0.043**
	(0.020)	(0.021)
Land	−0.007	
	(0.009)	
Supply	−0.0004	
	(0.011)	
Log(Food/Merchandise)	0.428**	0.451***
	(0.212)	(0.211)
Rural Population Growth	0.038	
	(0.112)	
Constant	−20.458	−20.923
	(10.495)**	(11.422)*
Control Function with Childmortality as Dependent Variable		
Natural Disaster	−1.831***	−1.760***
	(0.614)	(0.657)
Rho	−0.040**	−0.042*
	(0.020)	(0.021)
Observations	1675	1675
Note:	*p,z<0.1; **p,z<0.05; ***p,z<0.01	

Table 4.4.5: Model 2: Poisson Model with Multiplicative Error Term and Instrumental Variable Control Function with Lagged Instrumental Variable (Country Cluster)

	Dependent Variable: Aggregate Provision	
	Full Model	*Reduced Model*
Childmortality	0.029***	0.0370**
	(0.009)	(0.017)
WTO	−0.0729	−0.364
	(0.282)	(0.361)
ICESCR	0.447	0.472***
	(0.127)	(0.166)
Polity	1.242	1.407**
	(0.498)	(0.661)
Regime Durability	0.016	0.018**
	0.007	(0.008)
Log(GDP)	1.167***	1.528*
	0.424	(0.844)
GDP Growth	0.224**	0.026*
	(0.114)	(0.015)
Land	0.008	
	(0.007)	
Supply	−0.003	
	(0.008)	
Log(Food/Merchandise)	0.319**	0.396**
	(0.123)	(0.178)
Rural Population Growth	−0.008	
	(0.098)	
Constant	−13.664***	−17.631
	(4.460)	(8.966)**
Control Function with Childmortality as Dependent Variable		
Lag2(Natural Disaster)	−1.924***	−1.853***
	(0.522)	(0.665)
Rho	−0.030***	−0.036**
	(0.009)	(0.017)
Observations	1541	1541
Note:	*p,z<0.1; **p,z<0.05; ***p,z<0.01	

4.5 CONCLUSION

Given that RTAs are on average better for food security outcomes than BTAs, I looked more closely into how RTAs and food security are associated across the three sub-regions of Sub-Saharan Africa, Latin America and South East Asia. A comparative analysis of RTAs highlighted their commonalities, which set them apart from BTAs, but also indicated the heterogeneity of RTAs across and within the regions in the light of food security. Those commonalities and differences -the latter based on a comparative text analysis of food security relevant provisions - were comparatively summarised in a QCA. The analysis highlighted that the state of food insecurity might influence the design of trade agreements, and the specific design impacts the the state of food security. Accordingly, I formulated two hypotheses: First, more food security relevant provisions in RTAs, lead to better food security outcomes (Impact Model). Second, the more acute the state of food in-security the more likely it is for a country to entail a higher number of food security related provisions across its RTAs (Design Model).

To test the hypotheses I set up two distinct research designs and model specifications. To test the impact of the aggregate provisions on food security for 67 low and middle income countries which are member of at least one of the RTAs in the three sub-regions, 1990-2014, I fit a Dynamic model. Results, which have to be taken with caution, indicate that the more food security related provisions a country has across its RTAs, the better it is a for food security outcomes. This confirms the first hypothesis. Furthermore, it contributes to the literature by taken into account a more differentiated trade agreement variable which reflects the heterogeneity of RTAs in the light of food security.

To test whether the state of food security affects the design of a RTA, I fit a Count model,

which includes an instrumental variable, on the same data. Estimates indicate that the state of food security is indeed associated with the design. The more severe the state of food insecurity within a country, the more food security related provisions the country has across its RTAs.

While the qualitative analysis highlighted patterns of regional commonalities, the quantitative analysis further specified that RTAs within regions are sufficiently heterogeneous in the light of food security and should be analysed separately (rather than clustered).

In conlusion, the empirical results complement the QCA, and show that the pattern as shown by the introductory example of Kenya holds on average across the analysed countries. Countries which are less food secure bring food security relevant objectives to the regional negotiation table. RTAs with a higher number of food security and related provisions, lead on average to the intended better food security outcomes across the three regions.

CHAPTER 5

CONCLUSION

Different disciplinary and methodological lenses condition the views on whether trade is generally seen as an opportunity or threat for food security in theory (normative debate). The opportunity front is often grounded on primarily neo-classical economic theory which demonstrates efficiency gains via liberalisation; ultimately leading to improved food security. On the threat front, the different disciplines developed arguments by combining theory with observations in practice. Accordingly, a managed trade regime is influenced by power realities and the implications of this system are outlined in the dependency theory. The multilateral trading system, the WTO, is argued to be such managed trading regime which has restricted the policy space for food security of low and middle income countries. The implications as outlined in the dependency theory are the macro conditions which contribute to the individual violation of the human right to food of small scale farming families, as argued by human rights scholars and practitioners. The empirical literature has extensively dealt with the implications of liberalisation on economics growth (yet, remained inconclusive) but has neglected to further examine empirically the links between trade agreements as such and its impacts on a coherent food security proxy across countries.

In light of the proliferation of PTAs, the question is whether those have regained or created

policy space to contribute to better food outcomes. More specifically, I examined first, in Chapter 3, whether the relatively cooperative RTAs have a different impact than the relatively competitive BTAs. According to the findings RTAs are more better for food security outcomes than BTAs. Therefore, I then, in Chapter 4, looked into why RTAs are potentially good for food security outcomes and whether the state of food security influences the design of RTAs.

In detail, to operationalise one of the key variables of analysis 'food security', I developed a framework to identify different food (in-)security indicators, and to justify the selection of one for further analysis. The framework implies that food security is a latent concept which can be measured by the pivotal outcome-utilization indicators. The utilisation-outcome variables are the variables measuring the actual realisation of food (in-)security. While a confirmatory Structural Equation Approach confirmed this, limited data availability restricts to apply the latent variable approach over the period 1990-2014.

Given this shortcomings I selected child mortality as a proxy for food insecurity for the following reasons. The indicator child mortality reflects apart from individual outcomes under the utilization pillar complementary factors on the macro level (some of the control variables). Furthermore, child mortality is highly correlated with other food insecurity proxies of the utilization-outcome dimension such as anthropometric and biochemical indicators (see Annex B.2). Even though high correlation might not suggest interchangeability as Caspers and Tufis (2003) have shown in the context of democracy measures, in this context child mortality might reflect the other utilization-outcome variables well, as, e.g., child deaths are found to be attributable to undernutrition in low and middle income countries (Black et al. 2013).[1] Based on these reasons (besides data availability) the dependent variable of interest

[1] See also Campbell et al. 2009, who have shown that higher household food insecurity in Indonesia is associated with higher child mortality.

food security is proxied with child mortality as, e.g., done in Olper et al. (2014).[2]

The fact that the framework is vertically and horizontally integrated among the dimensions, implies that the suggested indicators of the dimensions other than the ultization-outcome one contribute to the explanation of the latent variable food insecurity (multidimensional). There is some (tenative/weak) indication based on the Multiple Indicators and Multiple Cause Model, that variables such as agricultural land, food production, political stability, GDP growth, growth of the rural population, health expenditure, access to sanitation, and access to water may contribute to the explanation of food security. Accordingly, some of these variables are, depending on data availability and pattern of missing across time and countries, included in the following analysis as control variables.

To answer the first question I regressed a coherent and harmonized food security proxy, child mortality, on trade agreements variables for 93 low and middle income countries for 1990-2014, by controlling for economic, political, social and human rights variables. The results of the analysis indicate that the multilateral trading system, WTO, has restricted the policy space for food security of low and middle income countries. PTAs, which are an exception to the WTO rules, can have an initial positive impact on food security, when contrasted to none being in place. However, an increase in the number of PTAs does not necessarily lead to improved food security outcomes. BTAs, which are often negotiated among asymmetric trading partners in a competitive manner and result in a more 'competitive' design, may enhance the managed trading regime, as an increase of these is negatively associated with food security outcomes. RTAs, which often entail common policies and objectives on food security and related - and are therefore in comparison more cooperative -, contribute to better food security outcomes.

[2] Child mortality, or other anthropometric variables, are referred to in the literature as a food security proxy. See, e.g., Olper et al. (2014) and McCorriston et al. (2013).

Building on these results, I analysed - to answer the second question - how RTAs and food security are associated across the three sub-regions, Sub-Saharan Africa, Latin America and South East Asia. A comparative analysis of RTAs highlighted commonalities of RTAs, which set them apart from BTAs, but also indicated the heterogeneity of RTAs across and within the regions in the light of food security. Those commonalities and differences -the latter based on a comparative text analysis of food security relevant provisions - were comparatively summarised in a QCA. The analysis highlighted that the state of food insecurity might influence the design of trade agreements, and the specific design again the state of food security. Accordingly, I formulated two hypotheses:[3] First, more food security relevant provisions in RTAs, lead to better food security outcomes (Impact Model). Second, the more acute the state of food in-security is the more likely it is for a country to entail a higher number of food security related provisions across the RTAs it is member of (Design Model).

To test the hypotheses I set up two distinct research designs and model specifications. To test the impact of the aggregate provisions on food security for 67 low and middle income countries which are member of at least one of the RTAs in the three sub-regions, 1990-2014, I fit a Dynamic model. Results, which have to be taken with caution, indicate that the more food security related provisions a country has across its RTAs, the better it is a for food security outcomes. This confirms the first hypothesis. Furthermore, it contributes to the literature by taken into account a more differentiated trade agreement variable which reflects the heterogeneity of RTAs in the light of food security.

To test whether the state of food security affects the design of a RTA, I fit a Count model, which includes an instrumental variable, on the same data. Estimates indicate that the state

[3] Please note that I elaborate more details for Chapter 4 than for Chapter 3, as Chapter 4 dealt with multiple approaches (and not just one as in Chapter 3): one qualitative analysis and two distinct quantitative models.

of food security is indeed associated with the design. The more severe the state of food insecurity within a country, the more food security related provisions the country has across its RTAs.

While the qualitative analysis highlighted patterns of regional commonalities, the quantitative analysis further specified that RTAs within regions are sufficiently heterogeneous in the light of food security and should be analysed separately (rather than clustered).

The empirical results complement the QCA. Countries which are less food secure bring food security relevant objectives to the regional negotiation tables. RTAs with a higher number of food security and related provisions, lead on average to the intended better food security outcomes across the three regions. The results of the Chapters indicate that RTAs are potentially an opportunity for food security - and the more food security and related concepts are addressed in the text, the greater the opportunity. In contrast, BTAs are potentially a threat to food security. These results add to the literature by indicating that trade agreements are not per se a threat or an opportunity for food security, but need to be further differentiated in light of food security relevant characteristics.

In the light of the results, it can be recommended that countries, if these have not already exhausted their options of regional integration (number of RTAs is limited due to its definition/construction), should focus on improving an efficient implementation of the concluded RTAs also by harmonising overlapping RTAs rather than initiating new BTAs. The African Continental Free Trade Area Agreement signed in March 2018 seems to set a good starting basis for doing so. The inclusion of food security provisions can enhance the positive effect of the RTAs. These provisions, however, may need to be further specified, for sustainable food security aims. Apart from the seemingly adverse effects of BTAs on food security in low

and middle income countries, the increasingly intervened bowl of any kind of noodles (see terms 'Spaghetti' and 'Noodle Bowl' in the literature) is creating an increasingly administrative burden and therefore a highly inefficient trading system. Moreover, given that BTAs are negotiated by bureaucrats in a competitive and power driven setting, these BTAs are not oriented on economic principles but politics.

Not only BTAs but also RTAs are a distortion to the multilateral trading system in theory. Yet, while RTAs can potentially become good building blocks of the multilateral system[4] and improve regional food security, these will most likely fail to solve sensitive and crucial (market distorting) issues such as agricultural subsidies more efficiently than multilateral negotiations. Conclusively, RTAs on their own are not the first answer and a multilateral system might provide the optimum platform in theory.

The (geo-)politcial shift within the WTO sets hope for the ongoing slow to stale Doha Round to have a more balanced outcome than the previous round, if concluded. If amongst other the Nairobi package is being lived up to, than the price-distorting direct export support to domestic farmers in mostly high income countries will be phased out, and hence, the markets will be regulated more in line with economic principles. However, WTO member states need to move beyond the mere declaratory text of the AoA and Marrakesh preamble, and concretely tackle further trade related issues which potentially hamper food security in low and middle income countries. Low and middle income countries learnt their lesson from the previous round and its implications, and hence, the only way forward for the multilateral trading system, which ideally promotes food security, is fair play. To say in the words of Kahlil Gibran: the exchange of the gifts of the earth ought to be done in love and kindly justice for there to be no hunger.

[4] Whether RTAs constitute stepping stones or stumbling blocks for the multilateral trading system is controversially discussed in the literature.

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APPENDIX A

APPENDIX CHAPTER 2

A.1 STATISTICAL MODEL: INTRODUCTION TO THE APPLIED METHOD

Confirmatory Factor Analysis (CFA)

Confirmatory factor analysis (CFA) is one form of structural equation modelling that measures the relationship between observed variables (items) and an unobservable latent variable (factor). CFA is applied to test a theory-driven hypothesis (Brown 2006). This means strictly speaking that the number of factors and the pattern of factor loadings (equivalent to coefficients/regression slopes) and unique variances in the indicators that is not accounted for by the latent factor(s) (measurement error, error variance, indicator unreliability) is predetermined a priori. Yet, often the specified model can be adjusted based on an evaluation of the goodness of fit, modification indices, the interpretability and strength of the resulting estimates (Brown 2006). The latter can be described as "model generating, rather than model testing" (Jöreskog 1993: p. 295).

Technically, the latent variable accounts for the variation and covariation among the here strongly interrelated outcome indicators (Brown2006). Accordingly, CFA is based on the

analysis of variance-covariance structures. In detail, the parameters (factor loadings, factor variances and covariances, error variances and covariances) are estimated to produce a predicted/hypothesized variance-covariance matrix $\mathbf{\Sigma}$ that resembles the sample variance-covariance matrix $\mathbf{S}$ as closely as possible. In other words, the difference (residuals) between the sample and the parameter/hypothesized variance-covariance matrices results is to be minimized (residual variance-covariance matrix = $\mathbf{S}$ - $\mathbf{\Sigma}$). The most commonly applied fitting function to minimize the difference (minimum discrepancy function) is maximum likelihood (ML), which maximises the likelihood of the parameters given the sample. If the indicators are not normally distributed, then ML with robust standard errors and mean adjusted χ^2 is to be preferred to correct for non-normality (χ^2 is mean-adjusted via a Satorra-Bentler scaling correction), or sandwich estimator with robust standard errors. Thus, the parameters are estimated by minimizing following fitting function (minimum discrepancy function):

$$F_{ML} = ln \mid \mathbf{S} \mid - ln \mid \mathbf{\Sigma} \mid + trace[(\mathbf{S})(\mathbf{\Sigma}^{-1})] - p \tag{A.1.1}$$

where $\mid \mathbf{S} \mid$ is the determinant of the sample variance-covariance matrix, $\mid \mathbf{\Sigma} \mid$ is the determinant of the predicted variance-covariance matrix, and p is the order of the sample matrix (i.e., the number of indicators).

Multiple Indicators and Multiple Causes (MIMIC)

As CFA, Multiple Indicators and Multiple Causes (MIMIC) of latent variable is one form of structural equation modelling that takes on a hypothesis driven approach. MIMIC consists of a measurement part to measure the latent variable and a structural part to regress the latent variable on covariates. For an example of a formal introduction of these, please refer to Subsection 4.2.

As for CFA, the differences between the predicted-hypothesized variance-covariance matrix $\boldsymbol{\Sigma}$ and the sample variance-covariance matrix $\mathbf{S}$ can be minimized via a maximum likelihood fitting function (minimum discrepancy function) as specified as follows:

$$F_{ML} = ln \mid \mathbf{S} \mid - ln \mid \boldsymbol{\Sigma} \mid + trace[(\mathbf{S})(\boldsymbol{\Sigma}^{-1})] - (p+q) \tag{A.1.2}$$

where $\mid \mathbf{S} \mid$ is the determinant of the sample variance-covariance matrix, $\mid \boldsymbol{\Sigma} \mid$ is the determinant of the predicted variance-covariance matrix, and *(p+q)* is the order of the sample matrix (i.e., the number of observed variables in the model).

Model Fit, Model Selection and Modification Indices

The aim of the SEM estimation, i.e. in the case of CFA and MIMIC, is to model parameters in such a way that the discrepancy between the predicted/hypothesized variance-covariance matrix Σ and the sample variance-covariance matrix S is minimized. Consequently, the goodness-of-fit is evaluated based on the differences between Σ and S. A number of fit indices have been suggested in the literature. For a as good as an exhaustive list and detailed elaborations please refer to West et al. 2012. Here, the most commonly referred to fit indices (χ^2, *RMSEA*, *CFI*, *TLI* and *SRMR*) and selection indices (*AIC*, *BIC*) are mathematically described in Table A.1.

Table A.1.1: Fit Indices and Model Selection Indices

Fit or Selection* Index	Name of Index/Reference	Criteria
$\chi^2 = (N-1)f$	Chi-Square Test Statistic Jöreskog (1969)	$p < .05$
$RMSEA = \sqrt{\frac{max(\chi^2 - df, 0)}{df(N-1)}}$	Root Mean Square Error of Approximation Steiger and Lind (1980)	$< .06$
$CFI = 1 - \frac{max(\chi_h^2 - df_h)}{max(\chi_0^2 - df_0)}$	Comparative Fit Index Bentler (1990)	$> .90/.95$ suggested cut of varies
$TLI = \frac{\chi_0^2/df_0 - \chi_h^2/df_h}{\chi_0^2/df_0 - 1}$	Tucker-Lewis Index Tucker and Lewis (1973)	$> .90/.95$ suggested cut of varies
$SRMR = [p^{-1}\mathbf{e}'\mathbf{W_s}\mathbf{e}]^{\mathbf{1/2}}$	Standardized Root Mean Square Residual Bentler (1995)	$< .08$
$AIC^* = f + 2q$	Akaike Information Criteria	least expected discrepancy the smaller the better
$BIC^* = f + qln(N)$	Bayesian Information Criteria	most likely Bayesian sense the smaller the better

Note: f - minimized discrepancy function; 0 - baseline model; h - tested or hypotehsized model; df - degrees of freedom; N - sample size; p - the number of nonduplicated elements in the covariance matrix; $\mathbf{e}$ - a vector of residuals from a covariance matrix; $\mathbf{W_s}$ - a diagonal weight matrix used to standardize the elements in a sample covariance matrix; q - number of free parameters of the model.

The Chi-Square Test with the null-hypothesis 'Σ is equal to S' (broadly speaking) is a very strict one and sensitive to sample size. Ideally the null is not to be rejected, but this often occurs. Therefore the other listed indices, might provide further guidance. For their advantages, disadvantages and shortcomings please refer to amongst others West et al. 2012.

Modification Indices as proposed by Sörbom (1989) provide guidance in whether single parameters should be freed. More technically, these indicate the decrease in the model's χ^2-statistic with one df if a parameter is relaxed from a constraint in the previous model. A parameter can be relaxed by, e.g., allowing residuals of items to covary. If the relaxation contributes to the improvement of the overall model fit and is substantively meaningful, then it

is recommended to take on the modified model structure (as long as it does not lead to over identification).

A.2 DATA: LIST OF COUNTRIES

Table A.2.1: List of 114 Low and Mid-Income Countries and Islands

ID	Country	ID	Country	ID	Country
1	Afghanistan	39	Georgia	77	Namibia
2	Albania	40	Ghana	78	Nepal
3	Algeria	41	Guatemala	79	Nicaragua
4	Angola	42	Guinea	80	Niger
5	Argentina	53	Guinea-Bissau	81	Nigeria
6	Armenia	44	Guyana	82	Pakistan
7	Azerbaijan	45	Haiti	83	Panama
8	Bangladesh	46	Honduras	84	Paraguay
9	Belarus	47	India	85	Peru
10	Belize	48	Indonesia	86	Philippines
11	Benin	49	Iran	87	Romania
12	Bhutan	50	Iraq	88	Rwanda
13	Bolivia	51	Jamaica	89	Samoa
14	Bosnia and Herzegovina	52	Jordan	90	Sao Tome Principe
15	Botswana	53	Kazakhstan	91	Senegal
16	Brazil	54	Kenya	92	Serbia
17	Bulgaria	55	Kiribati	93	Sierra Leone
18	Burkina Faso	56	Kyrgyzstan	94	Solomon Islands
19	Cambodia	57	Laos	95	South Africa
20	Cameroon	58	Lebanon	96	Sri Lanka
21	Cape (Cabo) Verde	59	Lesotho	97	Suriname
22	Central African Republic	60	Liberia	98	Swaziland
23	Chad	61	Macedonia	99	Tajikistan
24	China	62	Madagascar	100	Tanzania
25	Colombia	63	Malawi	101	Thailand
26	Congo	64	Malaysia	102	Timor-Leste
27	Costa Rica	65	Maldives	103	Togo
28	Cote d'Ivoire	66	Mali	104	Tonga
29	Cuba	67	Marshall Islands	105	Tunisia
30	Djibouti	68	Mauritania	106	Turkey
31	Dominican Republic	69	Mauritius	107	Tuvalu
32	Ecuador	70	Mexico	108	Uganda
33	Egypt	71	Micronesia	109	Ukraine
34	El Salvador	72	Moldova	110	Uzbekistan
35	Ethiopia	73	Mongolia	111	Vanuatu
36	Fiji	74	Montenegro	112	Vietnam
37	Gabon	75	Morocco	113	Yemen
38	Gambia	76	Mozambique	114	Zambia

APPENDIX B

APPENDIX CHAPTER 3

B.1 TRADE AGREEMENTS TERMINOLOGY

The applied terminology is distinct from the WTO terminology. Here, the term 'preferential trade agreements' refers to trade agreements which are preferential to the multilateral trade agreements under the WTO, and are used as an umbrella term. Preferential trade agreements can be differentiated into regional and bilateral agreements. Regional trade agreements involve at least three trading partners in the same geographical (sub-)region (Josling 2009, Bese et al. 2009). Bilateral trade agreements involve two trading partners in the same or not same region. Non-reciprocal arrangement schemes are not considered in this paper.

Figure B.1.1: Comparing WTO and Applied Terminology

	Description	WTO Terminology	Applied Terminology
I	Umbrella term for reciprocal trade agreements which are distinct from WTO agreements and an exception to the multilateral regime (yet governed by WTO law in most cases).	Regional Trade Agreements	Preferential Trade Agreements
II	Reciprocal trade agreements as described in I that involve at least three trading partners in the same geographical (sub-) region.	No distinction	Regional Trade Agreements
III	Reciprocal trade agreements as described in I that involve two trading partners in the same or not same region.	No distinction	Bilateral Trade Agreements
IV	Non-reciprocal preferential schemes.	Preferential Trade Arrangements	NA

B.2 Food Security Conceptual Framework

B.2.1 Definition

The most commonly referred to definition of food security was introduced during the World Food Summit 1996 and slightly modified in 2001[1]. Accordingly, food security exists when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food that meet their dietary needs and food preferences for an active and healthy life. Accordingly, the four pillars of food security are 1) availability, 2) access, 3) utilization and 4) stability.[2]

B.2.2 Four Pillars

The first pillar, food availability, the understanding of food security in the 1970s (Jones et al.2013; Maxwell 1996), describes the sufficient aggregate supply of food (per capita) through forms of domestic production (minus exports), imports, food stocks and food aid within a country or area (WFP 2009; Burchi and De Muro 2012; Simon 2012).

In 1981 Sen drew attention to the second pillar (economic) access by highlighting the importance of taking the economic conditions of people 'endowments', the command over entitlements, and 'exchange entitlement' into account (theory of entitlement). In detail, variables on households' endowments, the bundle of resources people originally own and the 'exchange entitlements', various alternative bundles that the person can acquire through the use of trade and production starting with each initial endowment (Drèze and Sen 1989) are essential in determining food security for individual households. Sen's entitlement approach is the underlying theoretical concept for the second pillar.

[1] By adding the wording 'social' (Clapp 2015).
[2] Annex B. is mainly but not entirely based on Chapter 2.

The third pillar, utilization, refers to an individual's "ability to select, take in and absorb the nutrients in food" (WFP 2009: p. 18). Amartya Sen and Jean Drèze refer in this context, in their 1989 publication, to the capability of individuals "to avoid undernourishment and escape deprivations associated with hunger" (Drèze and Sen 1989: p. 13).

The fourth pillar, stability and sustainability, is the requirement that the three pillars, availability, access and utilisation, are stable and also sustainable over time. In other words the fourth pillar incorporates the notion of long-term availability, permanency of access/accessibility (General Comment No. 12: para. 7) and some aspects of utilization (Frankenberger 1992; Barrett 2010; Burchi and De Muro 2012; Aurino 2013).

The first three concepts are hierarchically interdependent. Availability is conditional but not sufficient to ensure access. Access, in turn, is conditional but not sufficient for utilization (Barrett 2010). The fourth pillar adds the time dimension to the hierarchical interdependent three pillars.

B.2.3 Three Conceptual Levels

One way of operationalising the measurement of the complex food security concept is to make use of indicators. A food (in-)security indicator depicts a quantitative or a qualitative variable which measures a simplified version of one or some aspect of food (in-)security.

Indicators can be distinguished by whether they indicate levels of means or ends. The commonly referred to conceptual levels are input, process (activities), output (of these activities), outcome and impact. Input indicators refer to resources allocated to processes within a larger project. Process indicators can be activities, designed to meet a project's objectives,

with which the allocated resources are transformed into immediate tangible or non-tangible results, the output indicators. Process and output indicators describe the dynamics that lead to the outcome, which is closely linked to the final aims of the project and quantified by outcome indicators. Impact indicators depict the longer-term effects or higher-level goals to which the project aims to contribute to.

In the context of food security, Aurino (2014) differentiates between 1) input indicators and country structural conditions (indicators for in-depth country assessment), 2) output indicators of underlying determinants of country food security (indicators for action and modelling) and 3) outcome indicators (core food security indicators for global monitoring). Lintelo et al. (2014) identify indicators which reflect a government's commitment to reduce food insecurity to keep these separate from outcomes, which, according to the authors, cannot be controlled by governments. I keep the original terminology of structural, process and output, and outcome variables. Structural indicators are further distinguished into on the one hand legal framework, policy and programme, and on the other hand 'other underlying structural conditions'. Additionally, the idea of commitment indicators by Lintelo et al. (2014) is integrated in the framework. All in all, the three levels are, similar to the pillars, vertically interdependent. The structural indicators, condition the process indicators, and the latter have an influence on the outcome indicators.

B.2.4 The Framework

To operationalise the concept food security, a conceptual framework is introduced in Figure B.2.1. The framework syntheses information on theory, theory driven pillars and indicator levels, further information on aggregation levels and conversion factors. This framework facilitates the identification of potential variables; and a number of concrete indicators in-

cluding their source (author and/or data compiler) are listed in Figure B.2.1 as suggestions.

In detail, the framework combines the three pillars (Availability, Access and Utilization) with the three levels (Structural, Process and Outcome) into nine dimensions. Additionally, potential commitment indicators as suggested by Lintelo et al. 2014 are indicated across the dimensions (with preceding letter 'c'). As the introduction of the different pillars already indicated, indicators can be measured on different levels of aggregation: macro, meso and micro levels. In theory food availability is a concept mainly on the macro to meso level (country, region, community), access/accessibility on the macro (country) to micro (household) level, and utilization/acceptability/adequacy mainly on the micro level (household and individual) (Aurino 2013).

Access/accessibility does not only depend on availability but can also depend on a set of macro conversion factors (which condition and contextualise access) such as market structure including transparency, public goods and services and political freedoms.[3] One proxy for the macro conversion factors is the political stability variable - calculated by Brookings Institution and WB agencies, and compiled by FAO and WB. Once access is given, utilization depends on micro conversion factors such as age, gender, metabolism, pregnancy and health (as previously outlined) which convert accessed and then consumed food into individual nutritional outcomes (Drèze and Sen 1989; Aurino 2013).

Some of the indicators on the utilization outcome dimension, e.g., anaemia amongst pregnant women, have some of these micro conversion factors incorporated by definition and/or construction. In light of the micro conversion factors, food security and the right to food are in principle individual concepts. Disaggregation ideally allows an analysis of the variability

[3] See also Sen (1999) on instrumental freedoms: political freedoms, economic facilities, social opportunities, transparency guarantees, protective security (Aurino 2013).

of outcomes distributed within and between socio-economic groups (Devereux 2001; Haddad and Kanbur 1990; Pitt et al. 1990).

The selection of variables within each dimension is primarily based on the underlying combined theory of each pillar and indicator level. Given the hierarchical structure of the first three pillars and the vertical structure of the three levels, the utilization outcome indicators have a pivotal function and can be interpreted as the variables measuring the actual realisation of food (in-)security. For that reason, I considered for the the dependent variable measures of food security of that dimension only.

Figure B.2.1: Food Security Indicators within the Conceptual Framework

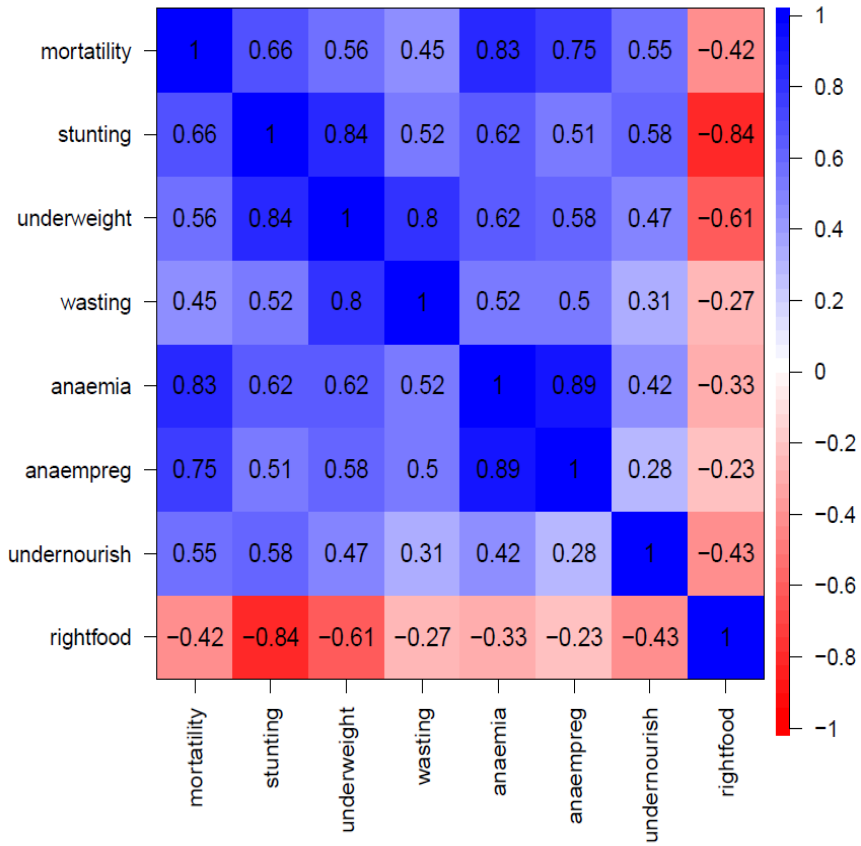
Level	Macro/Meso: country, region, community	⟷	Macro/Micro: country, households	⟷	Micro: individuals
Pillar	**Availability**		**Access/Accessibility**		**Utilization/Acceptability/Adequacy**
Theory	Supply≥Demand	Macro Conversion Factors	Entitlement	Micro Conversion Factors	Capability
Structural I legal framework, policy, programme,	- c: international human rights treaties relevant to the right to adequate food ratified by the state - c: coverage and implementation of the right to adequate food in the constitution or other forms of superior law				
	- c: national policy or programme on: agricultural production and food availability; drought, crop failure and disaster management - international trade agreements		- c: land law incl. women's access to land - c: social protection and inclusion policies		- c: national policy or programme on: food safety, consumer protection, nutrition
Structural II other structural conditions	- GDP per capita (growth) [WB] - agricultural land [WB] - agricultural irrigated land [WB] ◦ {climate, soil and water quality}	market structure incl. transparency, public goods and services, political freedoms (political stability [FAO])	- economic: GDP per capita (growth) [WB], long-term unemployment [WB], domestic food price index [FAO], inflation rate of consumer prices [WB], real effective exchange rate [WB], applied import tariff rate [ITC] - social: {c: social protection and inclusion} - physical: {geography, agricultural/food infrastructure}	age, gender, metabolism, pregnancy, health	- c: health expenditure per capita or of GDP [WB], diarrhoea treatment for children [WB], immunization children DPT, measles [WB], immunization newborns tetanus [WB] - c: expenditure on education [WB] - enrolment rate primary education [WB], literacy rate [WB] ◦ {climate, coverage of drinking water, sanitation, medical, processing and storage facilities}
Process and Output	- c: expenditure on agricultural research and development [ASTI] - GDP value added of agricultural sector [WB] ◦ {quality and net value output on farm level}		- economic: {households' capital and work income, disposable income, food consumption and expenditure by population groups} - social: {work participation rates by sector, social benefits} - physical: road density [WB], paved roads over total roads [WB], rail-lines density [WB], {food deserts, access to markets and stores}		- access to improved water source [WB] - access to improved sanitation facilities [WB] - access to electricity [WB] - consumption of iodized salt [WB] - vitamin A supplementation coverage rate among children [WB] ◦ {indicators on whether supplied food is culturally, medically and dietary adequate}
Outcome	- value of food production [FAO] - food production index [WB] - dietary energy supply adequacy [FAO] - food waste [FAO] - value of food imports over total merchandise exports [FAO] - cereal import dependency ratio [FAO] - (dependency on chronic food) aid [WFP] - food stocks [FAO] ◦ {per capita availability of major food items}		- GINI index [WB] - poverty gap or headcount ratio at $1.90 or $3.10 a day [WB] - share of food expenditure of the poor [FAO] - rural poverty gap or headcount ratio at national poverty lines [WB] - rural population growth [WB]		- stunting, underweight, wasting among children [UNICEF, WHO, WB] - anaemia among children [WB] - anaemia among pregnant women [WB] - mortality among children [WB] - prevalence of undernourishment [FAO] - prevalence of food inadequacy [FAO] - realisation of the right to food [SERF] ◦ {prevalence of iodine deficiency [FAO]} ◦ {prevalence of vitamin A deficiency among children [FAO]}
	Stability/Sustainability variables above over time (incl. variables on variability)				

Note: c - indicates government's commitment.

Source: Own adaption of WFP (2009), Aurino (2014), Burchi and De Muro (2012), EIU (2015), Jones et al. (2013), OHCHR (2012), Black et al. (2008), te Lintelo et al. (2014); Panagaribowo et al. (2013) following Adcock and Collier (2001), see also Landman and Carvalho (2010).

Besides the substantial reasons, as outline above, a key criteria for selection is data completeness. Out of all listed utlisation-outcomes indicators, *Child Mortality* is the only variable without missings for 93 middle and low income countries for 1990-2014.[4] Furthermore, *Child Mortality* is highly correlated with all other utlisation-outcomes indicators as presented in Figure B.2.2.[5]

Figure B.2.2: Pearson Correlation Matrix



[4]Missings per variable: *Stunting* (1728), *Underweight* (1706), *Wasting* (1730), *Anaemia* (279), *Anaemia among Pregnant Women* (279), *Prevalence of Undernourishment* (441), *Right to Food* (1395).

[5]Yet, high correlation might not suggest interchangeability as Caspers and Tufis (2003) have shown in the context of democracy measures.

B.2.5 FOOD SECURITY INDICATORS (UTILISATION-OUTOCME)

This subsection provides further more detailed descriptions on the utilisation-outcome food security indicators.

Anthropometric indicators: The most obvious indicators for indicating food insecurity are anthropometric indicators such as stunting (height-for-age), underweight (weight-for-age), and wasting (weight-for-height) (see also examples of undernourishment in subsection 'Theoretical Foundations and Four Pillars'). Stunting is an indicator of the failure to reach the growth potential and therefore it is often seen as an indicator for chronic hunger (Masset 2011). Some argue that the stunting indicator also reflects micronutrient deficiency (Walker et al. 2007). Underweight can be due to long term failure to grow but also due to short term weight loss and is, hence, not easily interpretable. Wasting is the consequence of acute starvation or disease, and portrays rather short term effects (Masset 2001).

These indicators are derived by comparing children under five years old (0-59 months) with a reference population which is estimated by the World Health Organization (WHO) and last reported in 2006 for children from different ethnicities and by gender (WHO Growth Reference Study Group 2006; Alkire et al. 2015). If children are below minus two standard deviations from median height-for-age, weight-for-age, or weight-for-height, of the reference population, then they are counted as stunted, underweight or wasted, respectively.

Country-level data is from national surveys and harmonised by The United Nations Children's Rights and Emergency Relief Organization (UNICEF), WHO and World Bank (WB) (in their harmonized global database on child growth and malnutrition), to make cross-country comparison more feasible. It can be interpreted that anthropometric measures reflect not only food intake conditioned by physical micro factors such as age and gender but also complementary factors on the macro level such as, amongst others, access to sanitation and health services (UNICEF 1990; Jones et al. 2013). Conclusively, anthropometric measures

make good utilization outcome indicators.

Biochemical indicators: Indicators which directly measure micronutrient deficiencies are biochemical indicators (also named biomarkers). Biochemical indicators indicating the concentration of amongst others iron, vitamin A and iodine deficiency, across countries are compiled by the WHO's Vitamin and Mineral Nutrition Information System (VMNIS)[6]. Yet, compiled data is not all comparable across countries and lack of data coverage is an issue. The indicator anaemia,[7] which provides some indication on iron, vitamin A, folate vitamin B12 deficiency amongst others might be the best indicator listed in terms of comparability across countries and data availability; and is therefore focused on. The indicators anaemia among children and anaemia among pregnant women measure the percentage of children under age five (6-59 months) and pregnant women (15-49 years), respectively, having anaemia. Anaemia is characterised by haemoglobin levels below 110 grams per litre at sea level, which are based on haemoglobin distributions estimated via a Bayesian hierarchical mixture model by the Nutrition Impact Model Study Group (Anaemia) (Stevens et al. 2013). Sources of input data are national health, nutrition and household surveys, plus summary statistics amongst others from the WHO's VMNIS. Conclusively, similar to anthropometric indicators, biochemical indicators make great outcome utilization indicators.

Mortality rate: A relatively less commonly referred to food insecurity indicator is the mortality rate amongst children which describes the probability per 1,000 that a newborn dies before reaching year five (0-4 years). It is listed as one of the potential outcome indicators for the right to food within the human rights indicator framework of the Office of the United Nations High Commissioner of Human Rights (2012), and is also included in the Global Hunger Index described further below. Additionally, given the high correlation with anthropometric

[6] For a complete list of VMNIS indicators see online: http://www.who.int/vmnis/indicators/en/.
[7] Anaemia is a condition in which the number of red blood cells is insufficient (WHO 2011).

and biochemical indicators, mortality rates are included in the review. Estimates are generated with a Bayesian B-spline bias-reduction model (Alkema and New 2014) by the United Nations Inter-Agency Group for Child Mortality Estimation with nationally representative data sourced from vital registration systems, populations censuses, household surveys, and sample registration systems (You et al. 2015). Similar to the indicators above, mortality rates reflect besides individual outcomes complementary factors on the macro level. Furthermore, child mortality rates possibly indicate fatal consequences of food insecurity and capture thereby, if so, long-term outcomes under the utilization pillar.

Prevalence of undernourishment: The prevalence of undernourishment (or food inadequacy), "expressed as the share of people in a national population not meeting their minimum food energy requirements" (de Haen et al. 2011: p. 761) is measured by the FAO. The methodology for estimating the prevalence of undernourishment (or food inadequacy) is based on the comparison of a probability distribution of the annual average of daily habitual dietary energy intake of a representative (average) individual in the reference population and a threshold level, called the minimum dietary energy requirement (MDER) for an active and healthy life based on a physical activity level of 1.55 (prevalence of undernourishment) or for an even higher physical activity level of 1.75 (prevalence of food inadequacy) (FAO 2013; Moltedo et al. 2014).

The FAO estimates dietary energy consumption per capita in a country by calculating per capita dietary energy supply based on FAO's food balance sheets. Per capita dietary energy supply is derived from data on production, trade, food stock changes, non-food uses and food waste and losses (FAO 2013). Access to the calories is estimated by assuming a probability distribution of habitual energy consumption (adoption of the skew-normal and skew-lognormal families of distributions introduced by Azzalini) defined by the mean dietary energy supply and the coefficient of variation. The coefficient of variation is based on sample

distributions of calorie consumption or food expenditures from available representative national household surveys (FAO 2013; de Haen et al. 2011). To calculate the MDER threshold, FAO employs a normative energy requirement standards based on the result of the joint FAO, WHO and UNU consultation of 2001 (FAO 2001; FAO 2013).

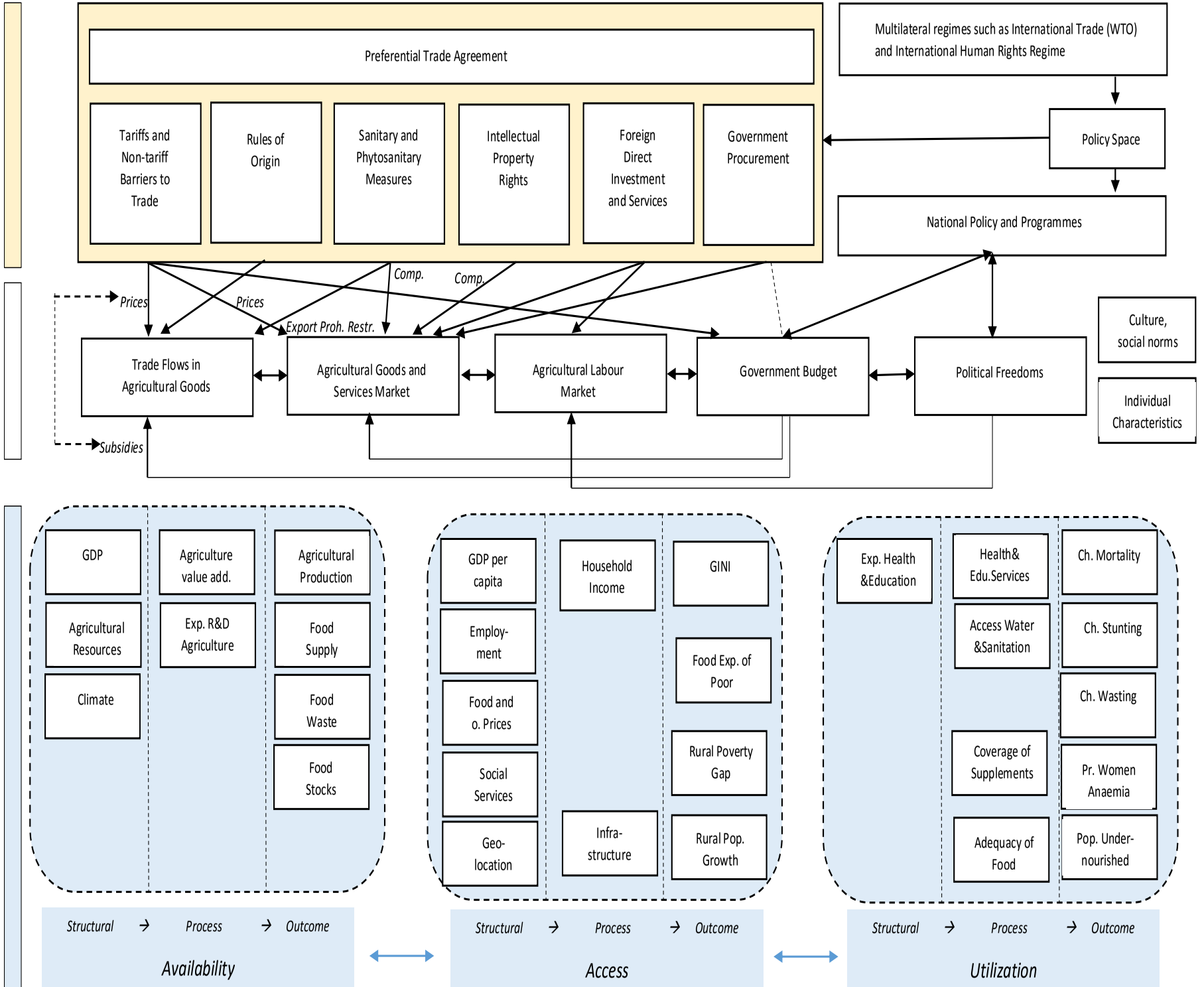
To summarize, the 'prevalence of undernourishment' indicator is estimated based on the quantity of calories available, the access to those calories among the population, and the mean minimum amount of calories required by the population (de Haen et al. 2011: p. 761). Therefore, in a strict sense, this indicator, even though it can represent substantively the concept of an access or utilization outcome indicator, is technically an indicator combining the availability and utilization pillar on the outcome level. FAO categorizes its measure as an access indicator. Here, for the purposes of further analysis, prevalence of undernourishment is based on its substantive interpretation categorized as an utilization outcome indicator.

SERF Right to Food Index: The SERF Right to Food Index by the Economic and Social Rights Empowerment Initiative is calculated based on two variables: stunting of children (for non-OECD countries) below five years and per capita GDP (PPP constant 2005 international dollars). The latter functions as the proxy for resource capacity to reflect the economic and social human rights concept of maximum available resources (see subsection 'Theoretical Foundations and Four Pillars'). GDP per capita is plotted against the stunting variables across non-OECD countries and time (1990-2006), resulting in a scatter plott. An achievement possibilities frontier (APF) is then fitted through the outer envelope of the scatter plot, indicating the benchmark level of obligation at any given GDP per capita. A rescaled performance indicator is calculated for each country and then compared with the relevant APF benchmark level. The difference reveals the percentage of feasible level of the right to food enjoyment achieved (Fukuda-Parr et al. 2011; Fukueda et al. 2015; see also Landman and Kersten 2016). Whilst this indicator technically combines the access and utilization pillar, it

is here categorized as an utilization outcome indicator adding in a human rights element by capturing the progressive realisation of the right to food.

B.3 Multiple Mechanisms

The overview depicts three levels: 1) the trade agreement and further policy level (yellow bar), 2) the (macro and micro) conversion factor level (white bar), and 3) the food security level (blue bar). The arrows symbolize direction of effects. The conversion factor level elements all interdependently affect the food security proxies under the three pillars availability, access and utilization. For graphical reasons effects between the conversation factor level and food security level are not explicitly shown.


Preferential Trade Agreement
Tariffs and Non-tariff Barriers to Trade
Rules of Origin
Sanitary and Phytosanitary Measures
Intellectual Property Rights
Foreign Direct Investment and Services
Government Procurement
Multilateral regimes such as International Trade (WTO) and International Human Rights Regime
Policy Space
National Policy and Programmes
Comp.
Comp.
Prices
Prices
Export Proh. Restr.
Trade Flows in Agricultural Goods
Agricultural Goods and Services Market
Agricultural Labour Market
Government Budget
Political Freedoms
Culture, social norms
Individual Characteristics
Subsidies
GDP
Agriculture value add.
Agricultural Production
Agricultural Resources
Exp. R&D Agriculture
Food Supply
Climate
Food Waste
Food Stocks
GDP per capita
Household Income
GINI
Employ-ment
Food Exp. of Poor
Food and o. Prices
Social Services
Rural Poverty Gap
Geo-location
Infra-structure
Rural Pop. Growth
Exp. Health &Education
Health& Edu.Services
Ch. Mortality
Access Water &Sanitation
Ch. Stunting
Ch. Wasting
Coverage of Supplements
Pr. Women Anaemia
Adequacy of Food
Pop. Under-nourished
Structural → Process → Outcome
Availability
Structural → Process → Outcome
Access
Structural → Process → Outcome
Utilization

B.4 Descriptive Statistics for Dataset with MAR

Figure B.4.1: Summary Statistics for Dataset MAR

Variable		Mean	Std. Dev.	Min	Max	Observations
Childm~y	overall	77.44142	58.37455	5	264.3	N = 2325
	between		53.53278	8.36	213.124	n = 93
	within		23.90449	-12.97858	170.8214	T = 25
PTAD	overall	.7174194	.450351	0	1	N = 2325
	between		.2792416	0	1	n = 93
	within		.354465	-.2025806	1.517419	T = 25
PTA	overall	1.60172	2.04691	0	16	N = 2325
	between		1.226432	0	6.16	n = 93
	within		1.643545	-4.55828	11.44172	T = 25
RTA	overall	.8593548	.7230556	0	3	N = 2325
	between		.5399392	0	2.44	n = 93
	within		.4840307	-.9806452	2.019355	T = 25
BTA	overall	.7458065	1.858456	0	16	N = 2325
	between		1.130627	0	6.16	n = 93
	within		1.47944	-5.414194	10.58581	T = 25
WTO	overall	.7316129	.4432155	0	1	N = 2325
	between		.385276	0	1	n = 93
	within		.2225652	-.2283871	1.691613	T = 25
ICESCR	overall	1.667957	.7303545	0	2	N = 2325
	between		.5677043	0	2	n = 93
	within		.4630959	-.252043	2.947957	T = 25
Polity	overall	.6007363	.3043188	0	1	N = 2241
	between		.268473	.008	1	n = 93
	within		.1453519	-.0692637	1.156736	T-bar = 24.0968
RegimeD	overall	15.9668	18.01674	0	97	N = 2289
	between		15.55132	0	83	n = 93
	within		9.152305	-38.9932	82.1268	T-bar = 24.6129
Conflict	overall	.3295351	.7503597	0	7	N = 2194
	between		.661415	0	4.68	n = 88
	within		.3633834	-2.350465	2.938231	T-bar = 24.9318
GDP	overall	5683.052	4805.238	246.6705	29173.61	N = 2176
	between		4711.877	630.4552	22979.41	n = 89
	within		1490.305	-6272.925	13877.28	T-bar = 24.4494
GDPgr	overall	2.2164	6.253777	-62.21435	104.6576	N = 2209
	between		2.04877	-2.47023	11.31605	n = 91
	within		5.923839	-62.45113	104.4208	T-bar = 24.2747
Land	overall	42.79345	19.85093	.4487179	83.98131	N = 2196
	between		19.67584	.52711	80.15639	n = 93
	within		2.587042	23.90785	58.92249	T = 23.6129
Supply	overall	110.4317	15.11848	69	165	N = 1939
	between		14.3663	87.05	157.2174	n = 86
	within		5.606544	83.51862	134.5186	T-bar = 22.5465
FoodMe~h	overall	43.05172	99.89693	1	1180	N = 1953
	between		87.92922	2	656.5	n = 91
	within		46.69299	-248.4483	892.8295	T = 21.4615
RuralPop	overall	.9899715	1.487036	-7.723459	10.9086	N = 2325
	between		1.243968	-1.962406	3.585175	n = 93
	within		.8245009	-9.905811	8.726247	T = 25
Water	overall	76.23547	18.33424	13.2	100	N = 2264
	between		17.26077	32.852	99.852	n = 93
	within		6.269529	52.53947	103.2355	T-bar = 24.3441
Sanita~n	overall	51.95182	28.57114	2.6	98.6	N = 2252
	between		28.22376	10.076	97.972	n = 93
	within		5.85821	30.57087	80.97087	T-bar = 24.2151

Figure B.4.2: Histograms I

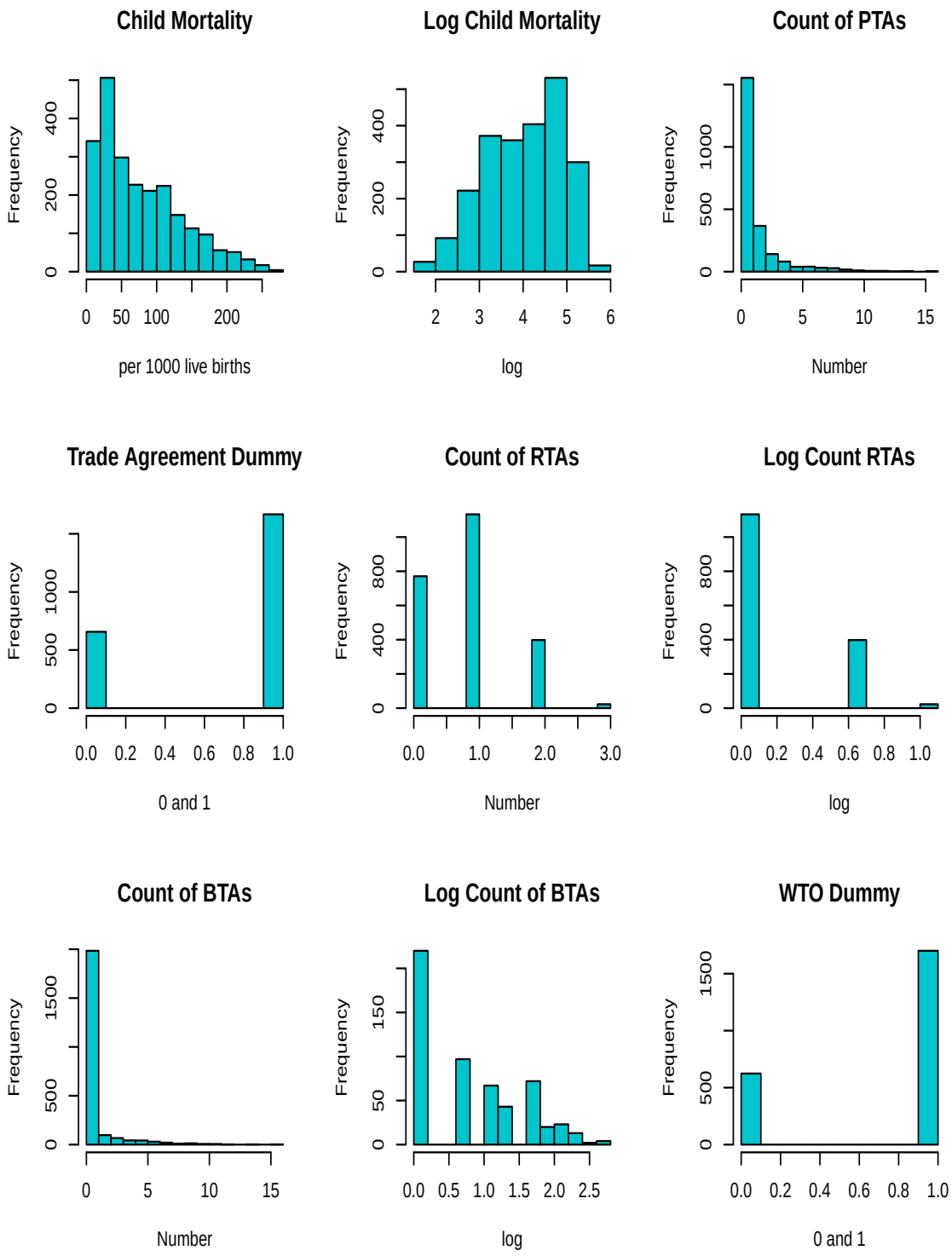


Figure B.4.3: Histograms II

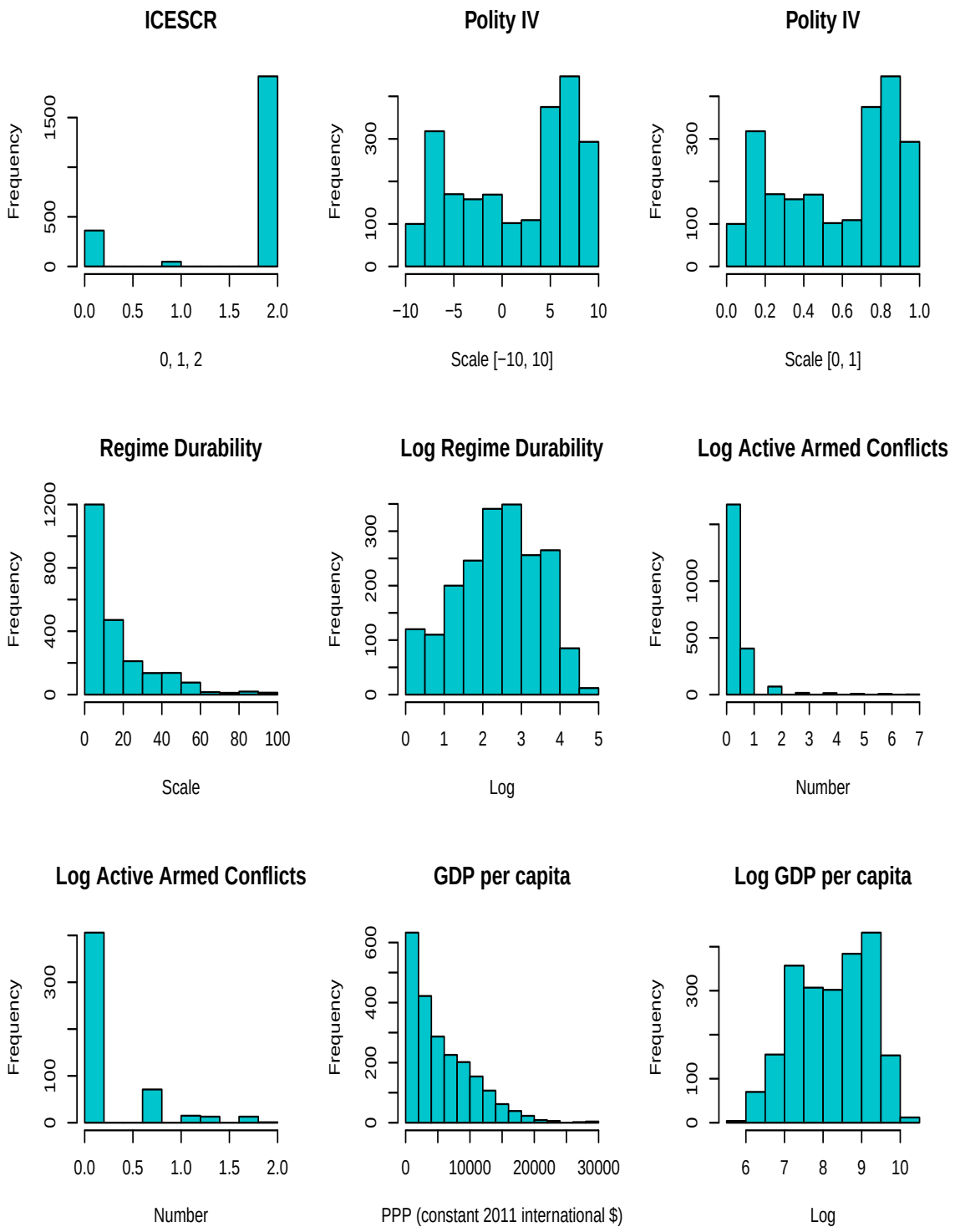


Figure B.4.4: Histograms III

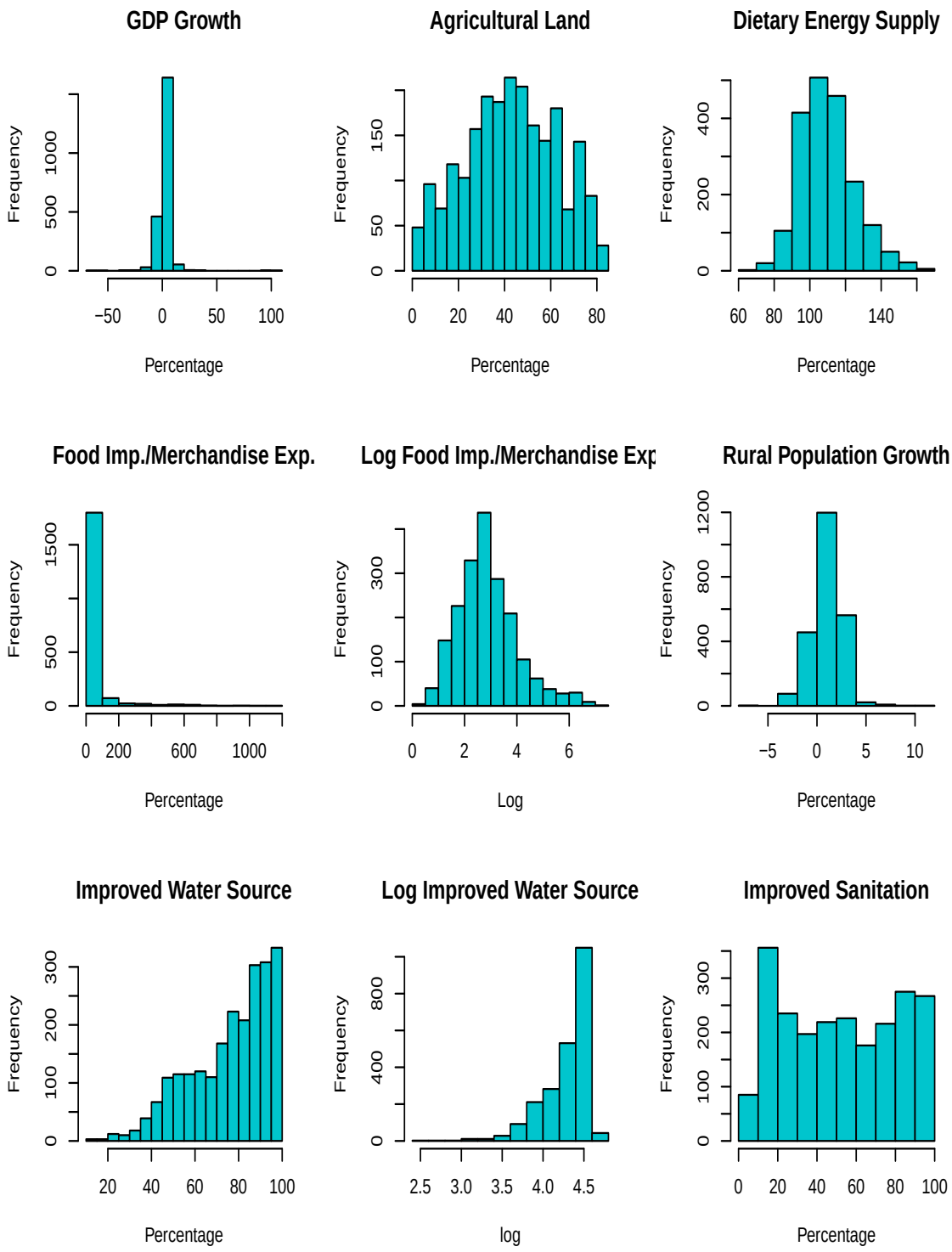


Figure B.4.5: Pearson Correlation Matrix

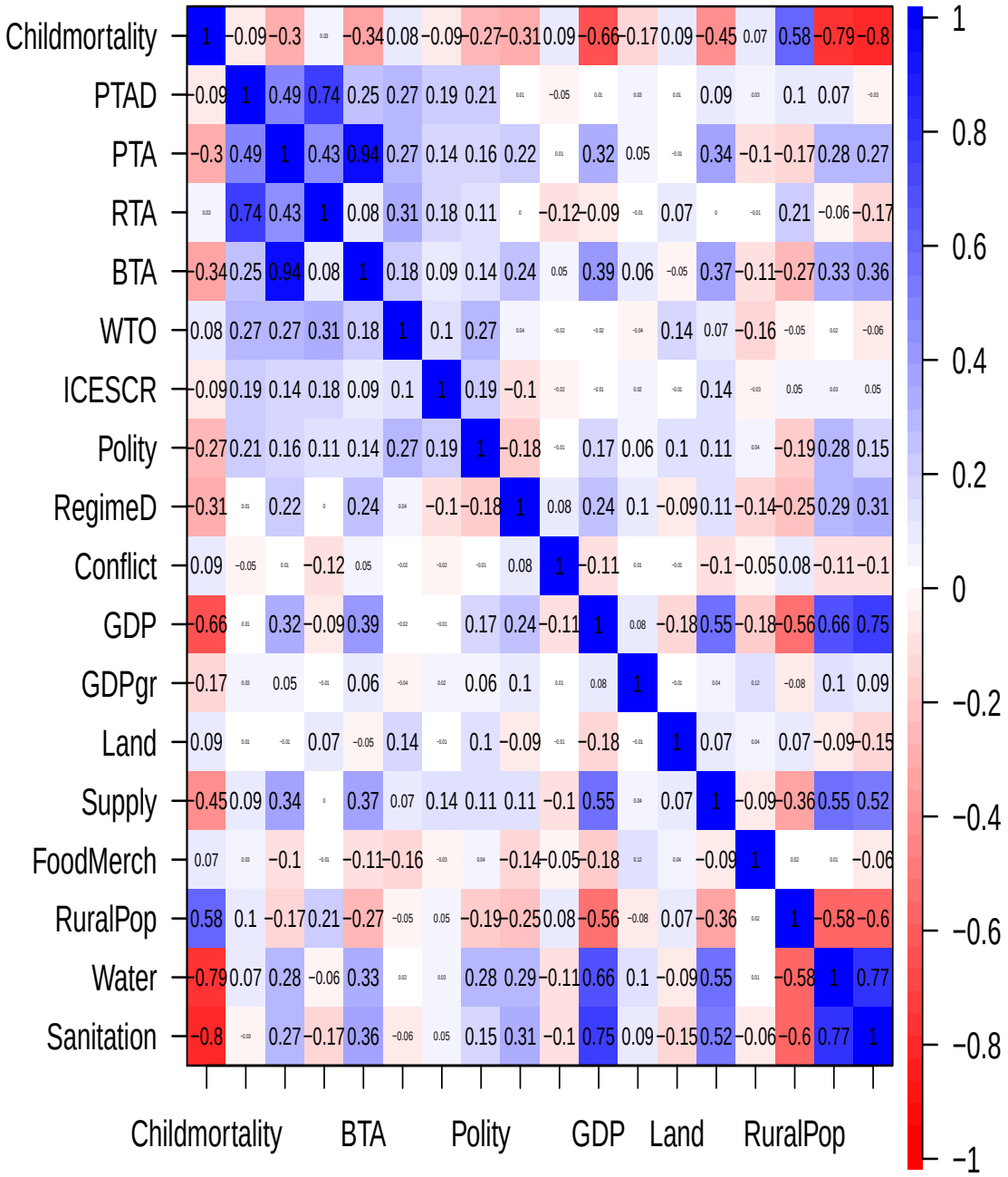
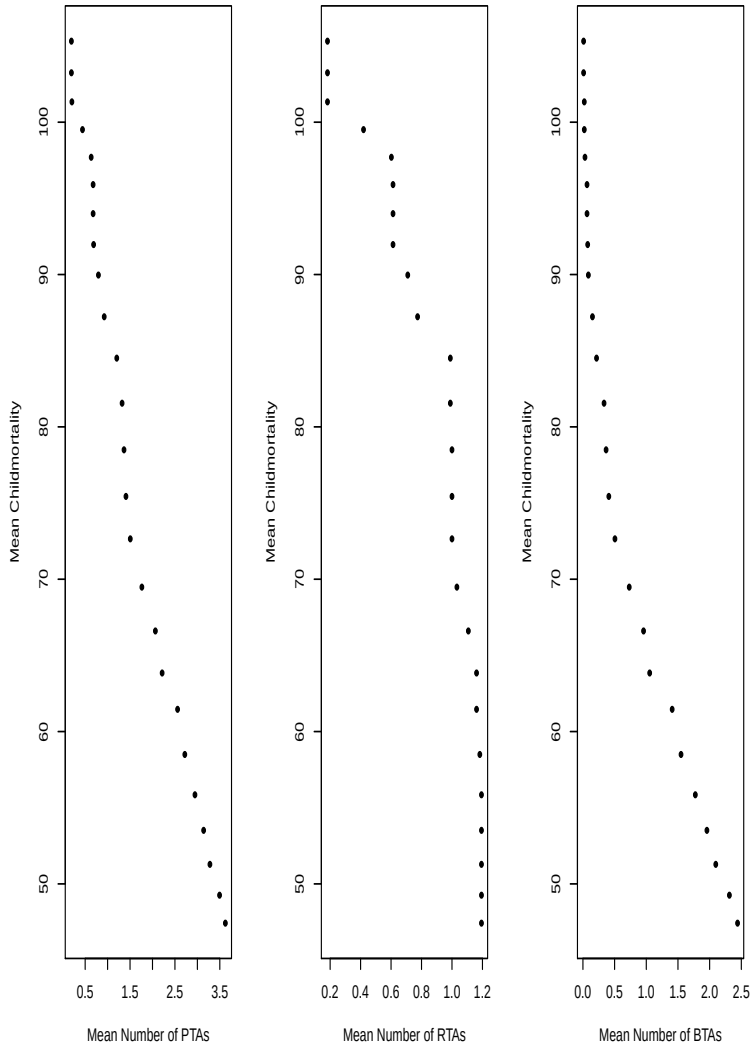


Figure B.4.6: Scatter Plots



B.5 Missing at Random and Multiple Imputation

The original dataset has about 4 percent missing observations (missing at random). In detail, following variables have following number of missings, listed in descending order and presented in Figure B.5.1: Supply (386), Food Imports over Merchandise Exports (FoMe) (372), GDP (149), Conflict (131), Land (129), GDP growth (116), Polity (84), Sanitation (73), Water (61), Regime Durability (RegimeD) (36).

Figure B.5.1: Pattern of Missings in Original Dataset

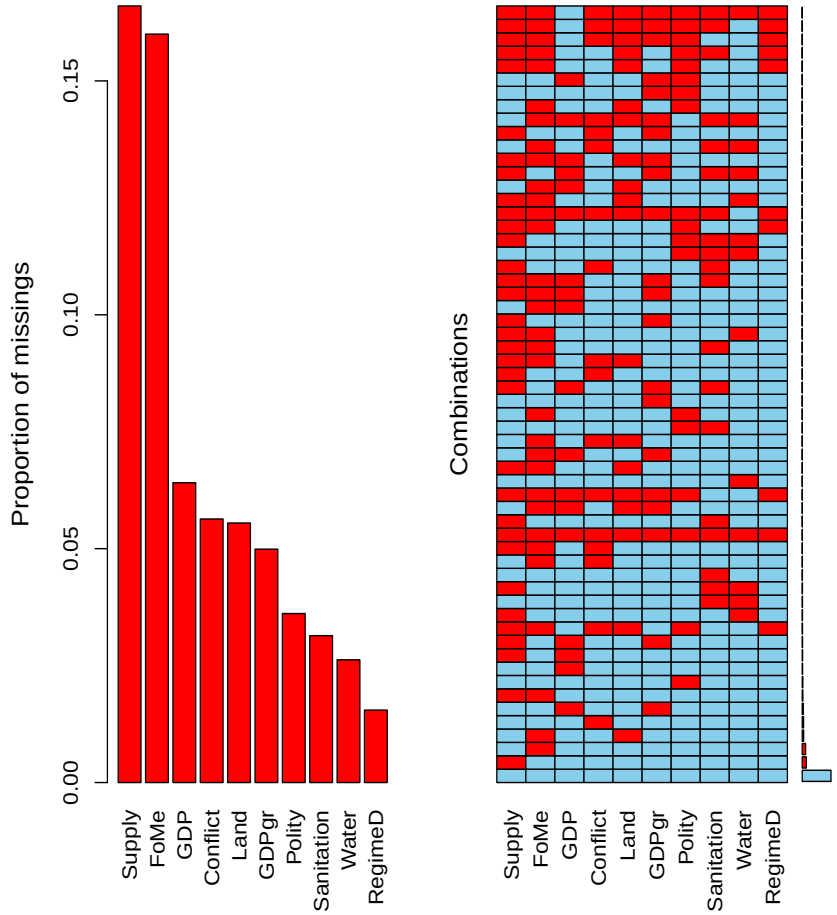


Figure B.5.2: Summary Statistics for Imputed Dataset

Variable		Mean	Std. Dev.	Min	Max	Observations	
Childm~y	overall	77.44142	58.37455	5	264.3	N =	2325
	between		53.53278	8.36	213.124	n =	93
	within		23.90449	-12.97858	170.8214	T =	25
PTAD	overall	.7174194	.450351	0	1	N =	2325
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PTA	overall	1.60172	2.04691	0	16	N =	2325
	between		1.226432	0	6.16	n =	93
	within		1.643545	-4.55828	11.44172	T =	25
RTA	overall	.8593548	.7230556	0	3	N =	2325
	between		.5399392	0	2.44	n =	93
	within		.4840307	-.9806452	2.019355	T =	25
BTA	overall	.7458065	1.858456	0	16	N =	2325
	between		1.130627	0	6.16	n =	93
	within		1.47944	-5.414194	10.58581	T =	25
WTO	overall	.7316129	.4432155	0	1	N =	2325
	between		.385276	0	1	n =	93
	within		.2225652	-.2283871	1.691613	T =	25
ICESCR	overall	1.667957	.7303545	0	2	N =	2325
	between		.5677043	0	2	n =	93
	within		.4630959	-.252043	2.947957	T =	25
Polity	overall	.6051105	.3005473	0	1	N =	2325
	between		.2634091	.008	1	n =	93
	within		.1471762	-.0648895	1.161111	T =	25
RegimeD	overall	16.04283	17.89496	0	97	N =	2325
	between		15.42239	.52	83	n =	93
	within		9.210623	-38.91717	82.20283	T =	25
Conflict	overall	.3252172	.7304738	0	7	N =	2325
	between		.6408004	0	4.68	n =	93
	within		.3566613	-2.354783	2.961617	T =	25
GDP	overall	5850.309	4824.807	246.6705	29173.61	N =	2325
	between		4549.669	630.4552	17937.35	n =	93
	within		1671.239	-3933.64	17247.85	T =	25
GDPgr	overall	2.238547	6.107908	-62.21435	104.6576	N =	2325
	between		1.928738	-2.47023	9.698173	n =	93
	within		5.798701	-62.60073	104.2712	T =	25
Land	overall	42.84596	19.37049	.4487179	83.98131	N =	2325
	between		18.92796	2.3153	79.19134	n =	93
	within		4.544011	1.28103	85.76252	T =	25
Supply	overall	110.4385	14.50498	69	165	N =	2325
	between		13.01714	87.092	153.4896	n =	93
	within		6.534414	66.97892	147.3329	T =	25
FoodMe~h	overall	41.72429	92.42895	1	1180	N =	2325
	between		77.16506	3.424	581.762	n =	93
	within		51.47967	-513.1077	915.3575	T =	25
RuralPop	overall	.9899715	1.487036	-7.723459	10.9086	N =	2325
	between		1.243968	-1.962406	3.585175	n =	93
	within		.8245009	-9.905811	8.726247	T =	25
Water	overall	76.39469	18.31634	13.2	100	N =	2325
	between		17.22393	32.852	99.852	n =	93
	within		6.472105	48.94633	103.3947	T =	25
Sanita~n	overall	52.21241	28.57491	2.6	98.6	N =	2325
	between		28.01071	10.076	97.972	n =	93
	within		6.326803	22.51809	85.71253	T =	25

B.6 Results of Alternative Models

B.7 List of Countries

Table B.6.1: Mixed Effects

	Dependent Variable: Food Insecurity		
	(1)	(2)	(3)
PTA Dummy	−10.128***		
	(1.009)		
PTA		0.604***	
		(0.234)	
RTA			−9.506***
			(0.731)
BTA			1.704***
			(0.237)
WTO	6.018***	3.499**	4.179***
	(1.489)	(1.508)	(1.445)
ICESCR	0.994	0.017	0.112
	(0.734)	(0.747)	(0.715)
Polity	−23.009***	−27.412***	−21.094***
	(2.404)	(2.426)	(2.364)
Reg. Durability	−0.115***	−0.121***	−0.138***
	(0.035)	(0.036)	(0.035)
Conflict	0.133	−0.177	0.196
	(0.864)	(0.881)	(0.844)
Log(GDP)	−6.698***	−9.303***	−11.455***
	(1.980)	(2.061)	(1.979)
GDP Growth	−0.203***	−0.211***	−0.182***
	(0.054)	(0.055)	(0.052)
Land	−0.142**	−0.158**	−0.134**
	(0.065)	(0.066)	(0.063)
Supply	−0.145**	−0.208***	−0.162***
	(0.057)	(0.058)	(0.056)
Log(Food/Merchandise)	−1.122*	−1.015	−1.649***
	(0.634)	(0.651)	(0.625)
Rural Pop. Growth	0.865**	0.736*	0.611
	(0.405)	(0.413)	(0.396)
Water	−1.925***	−2.015***	−1.738***
	(0.069)	(0.070)	(0.070)
Sanitation	−0.361***	−0.407***	−0.457***
	(0.062)	(0.064)	(0.062)
Constant	340.826***	377.169***	375.796***
	(14.325)	(15.235)	(14.588)
Observations	2,325	2,325	2,325
Log Likelihood	-9,764.937	-9,810.916	-9,710.314
Akaike Inf. Crit.	19,563.880	19,655.830	19,456.630
Bayesian Inf. Crit.	19,661.650	19,753.610	19,560.150
Note:			*p<0.1; **p<0.05; ***p<0.01

Table B.6.2: Fixed Effects and Lagged Dependent Variable Robust

	Dependent Variable: Food Insecurity		
	(1)	(2)	(3)
Lag(Food Insec.)	0.351***	0.350***	0.341***
	(0.038)	(0.040)	(0.040)
PTA Dummy	−9.829***		
	(2.134)		
PTA		0.395	
		(0.396)	
RTA			−8.677***
			(1.961)
BTA			1.296***
			(0.487)
WTO	2.107	0.178	0.493
	(2.991)	(3.225)	(2.839)
ICESCR	−0.151	−0.918	−0.940
	(1.551)	(1.644)	(1.589)
Polity	−22.304***	−26.485***	−20.584***
	(6.023)	(6.661)	(6.019)
Regime Durability	−0.052	−0.054	−0.070
	(0.071)	(0.074)	(0.068)
Conflict	0.287	−0.101	0.322
	(1.227)	(1.118)	(1.146)
Log(GDP)	3.315	0.392	−1.408
	(5.261)	(5.616)	(5.208)
GDP Growth	−0.159***	−0.167***	−0.143***
	(0.053)	(0.060)	(0.054)
Land	−0.042	−0.052	−0.038
	(0.110)	(0.118)	(0.106)
Supply	−0.141	−0.191	−0.154
	(0.117)	(0.124)	(0.113)
Log(Food/Merchandise)	−0.068	0.110	−0.489
	(1.505)	(1.570)	(1.536)
Rural Pop. Growth	0.498	0.349	0.209
	(0.658)	(0.696)	(0.631)
Water	−1.465***	−1.549***	−1.301***
	(0.285)	(0.300)	(0.281)
Sanitation	−0.240	−0.308	−0.330*
	(0.188)	(0.215)	(0.193)

Note: *p<0.1; **p<0.05; ***p<0.01

Table B.7.1: List of 93 Low and Middle Income Countries and Islands

ID	Country	ID	Country	ID	Country
1	Afghanistan	39	Guinea-Bissau	77	Sierra Leone
2	Albania	40	Guyana	78	South Africa
3	Algeria	41	Honduras	79	Sri Lanka
4	Angola	42	India	80	Sudan
5	Argentina	53	Indonesia	81	Suriname
6	Bangladesh	44	Iran	82	Swaziland
7	Benin	45	Jamaica	83	Syria
8	Bhutan	46	Jordan	84	Tanzania
9	Bolivia	47	Kenya	85	Thailand
10	Bosnia and Herzegovina	48	Korea, Dem. Rep.	86	Togo
11	Botswana	49	Laos	87	Tunisia
12	Brazil	50	Lebanon	88	Turkey
13	Burkina Faso	51	Lesotho	89	Uganda
14	Burundi	52	Liberia	90	Vietnam
15	Cambodia	53	Libya	91	Yemen
16	Cameroon	54	Macedonia	92	Zambia
17	Cape (Cabo) Verde	55	Madagascar	93	Zimbabwe
18	Central African Republic	56	Malawi		
19	Chad	57	Malaysia		
20	China	58	Mali		
21	Colombia	59	Mauritius		
22	Comoros	60	Mexico		
23	Congo, Dem. Rep.	61	Mongolia		
24	Congo, Rep.	62	Montenegro		
25	Costa Rica	63	Morocco		
26	Cote d'Ivoire	64	Mozambique		
27	Cuba	65	Myanmar/Burma		
28	Djibouti	66	Namibia		
29	Dominican Republic	67	Nepal		
30	Ecuador	68	Nicaragua		
31	Egypt	69	Nigeria		
32	El Salvador	70	Pakistan		
33	Ethiopia	71	Panama		
34	Gabon	72	Paraguay		
35	Gambia	73	Peru		
36	Ghana	74	Philippines		
37	Guatemala	75	Senegal		
38	Guinea	76	Serbia		

APPENDIX C

APPENDIX CHAPTER 4

C.1 TRADE AGREEMENTS TERMINOLOGY

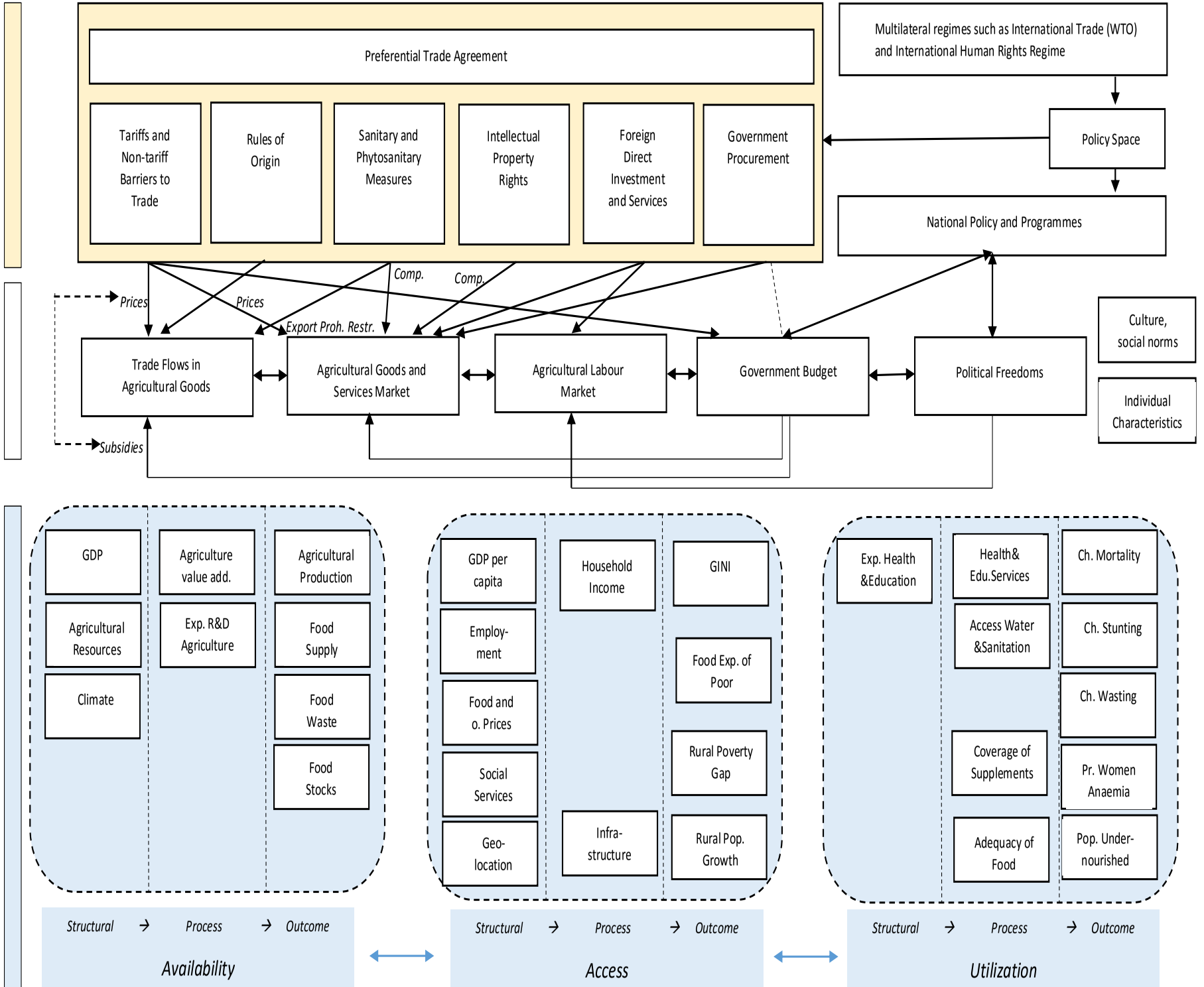
The applied terminology is distinct from the WTO terminology. Here, the term 'preferential trade agreements' refers to trade agreements which are preferential to the multilateral trade agreements under the WTO, and are used as an umbrella term. Preferential trade agreements can be differentiated into regional and bilateral agreements. Regional trade agreements involve at least three trading partners in the same geographical (sub-)region (Josling 2009). Bilateral trade agreements involve two trading partners in the same or not same region. Non-reciprocal arrangement schemes are not considered in this paper.

Figure C.1.1: Comparing WTO and Applied Terminology

	Description	WTO Terminology	Applied Terminology
I	Umbrella term for reciprocal trade agreements which are distinct from WTO agreements and an exception to the multilateral regime (yet governed by WTO law in most cases).	Regional Trade Agreements	Preferential Trade Agreements
II	Reciprocal trade agreements as described in I that involve at least three trading partners in the same geographical (sub-) region.	No distinction	Regional Trade Agreements
III	Reciprocal trade agreements as described in I that involve two trading partners in the same or not same region.	No distinction	Bilateral Trade Agreements
IV	Non-reciprocal preferential schemes.	Preferential Trade Arrangements	NA

C.2 Multiple Mechanisms

The overview depicts three levels: 1) the trade agreement and further policy level (yellow bar), 2) the (macro and micro) conversion factor level (white bar), and 3) the food security level (blue bar). The arrows symbolize direction of effects. The conversion factor level elements all interdependently affect the food security proxies under the three pillars availability, access and utilization. For graphical reasons effects between the conversation factor level and food security level are not explicitly shown


Preferential Trade Agreement
Tariffs and Non-tariff Barriers to Trade
Rules of Origin
Sanitary and Phytosanitary Measures
Intellectual Property Rights
Foreign Direct Investment and Services
Government Procurement
Multilateral regimes such as International Trade (WTO) and International Human Rights Regime
Policy Space
National Policy and Programmes
Comp.
Comp.
Prices
Prices
Export Proh. Restr.
Trade Flows in Agricultural Goods
Agricultural Goods and Services Market
Agricultural Labour Market
Government Budget
Political Freedoms
Culture, social norms
Individual Characteristics
Subsidies
GDP
Agriculture value add.
Agricultural Production
Agricultural Resources
Exp. R&D Agriculture
Food Supply
Climate
Food Waste
Food Stocks
GDP per capita
Household Income
GINI
Employ-ment
Food Exp. of Poor
Food and o. Prices
Social Services
Rural Poverty Gap
Geo-location
Infra-structure
Rural Pop. Growth
Exp. Health &Education
Health& Edu.Services
Ch. Mortality
Access Water &Sanitation
Ch. Stunting
Ch. Wasting
Coverage of Supplements
Pr. Women Anaemia
Adequacy of Food
Pop. Under-nourished
Structural → Process → Outcome
Availability
Structural → Process → Outcome
Access
Structural → Process → Outcome
Utilization

C.3 DETAILS ON RTAS

The first table, Table C.3.1 summarises key characteristics including the type of trade agreement (implying the degree of liberalisation), the year of entry, number of member states (breadth), the number of countries which were former colonies and/or occupied in any other way (since the 19th century, i.e., excluding the United States which gained independence before), and whether a common official language is shared among member countries.

Table C.3.1: RTA Key Characteristics

Abbreviation	Type	Entry/Modified	No of Members	Former Colonies	Common Language
Africa					
EAC	CU	2000	5	5	No
ECOWAS	FTA	1975/1993	15	15	No
CEMAC	CU	1998	6	6	Yes
COMESA	FTA	1994	19 FTA	17	No
SACU	CU	2004	5	5	Yes
SADC	FTA	2000	15, 13 FTA	15	No
WAEMU	CU	1994/2000	8	8	No
America					
CAN	CU	1969/1988	4	4	Yes
CAFTA	FTA+EIA	2001	5	5	Yes
CACM	CU	1961/1993	5	5	Yes
NT+C	FTA	2009	4	4	Yes
MERCOSUR	CU+EIA	1991/2005	5	5	No
NAFTA	FTA+EIA	1994	3	2	No
Asia					
AFTA	FTA	1993	10	9	No
SAFTA	FTA	2006	8	6	No

The second table, Table C.3.2 lists the member states to each RTA.

Table C.3.2: RTA Member States

Abbreviation	Member States
Africa	
EAC	Burundi, Kenya, Tanzania, Uganda, Rwanda
ECOWAS	Benin, Burkina Faso, Cape Verde, Cote d'Ivoire, Gambia, Ghana, Guinea, Guinea Bissau, Liberia, Mali, Niger, Nigeria, Senegal, Sierra Leone, Togo
CEMAC	Cameroon, Central African Rep., Chad, Rep. of Congo, Gabon, Equatorial Guinea
COMESA	Burundi, Comoros, Dem. Rep. Congo, Djibouti, Egypt, Eritrea, Ethiopia, Kenya, Libya, Madagascar, Malawi, Mauritius, Rwanda, Seychelles, Rep. Sudan, Swaziland, Uganda, Zambia, Zimbabwe
SACU	Botswana, Lesotho, Namibia, South Africa, Swaziland
SADC	Botswana, Dem. Rep. Congo (not in FTA), Lesotho, Madagascar, Malawi, Mauritius, Mozambique, Namibia, Seychelles, South Africa, Swaziland, Tanzania, Zambia Zimbabwe, Angola (not in FTA)
WAEMU	Benin, Burkina Faso, Ivory Coast, Guinea-Bissau, Mali, Niger, Senegal, Togo
America	
CAN	Bolivia, Colombia, Ecuador, Peru
CAFTA	Costa Rica, Dominican Republique, El Salvador, Honduras, Nicaragua
CACM	El Salvador, Costa Rica, Guatemala, Honduras, Nicaragua
NT+C	Colombia, El Salvador, Guatemala, Honduras
MERCOSUR	Argentina, Brazil, Paraguay, Uruguay, Venezuela
NAFTA	Canada, Mexico, United States
Asia	
AFTA	Brunei Darussalam, Cambodia, Indonesia, Laos, Malaysia, Myanmar, Philippines, Singapore, Thailand, Vietnam
SAFTA	Afghanistan, Bangladesh, Bhutan, India, Maldives, Nepal, Pakistan, Sri Lanka

The following figures, Figure 3, presents the underlying data for the analysis as described in the main text in the context of the QCA. Following RTA member state countries are not included in the statistical analysis as these are not a low or middle income country, not located in one of the three sub-regions, or have too many missing data and/or not random pattern of missing data, or are an outlier: Brunei-Darussalam, Canada, Dominican Republic, Egypt, Eritrea, Libya, Maldives, Niger, Rwanda, Seychelles, Singapore, United States, Uruguay, Venezuela.

Figure 3: Mean Food Insecurity 2014 by RTA

Country	Childmortality	Africa	EAC	ECOWAS	CEMAC	COMESA	SACU	SADC	WAEMU	America	CAN	CAFTA	CACM	NT-C	MERCO.	NAFTA	Asia	AFTA	SAFTA
Afghanistan	93.9																93.9		93.9
Argentina	12.9									12.9					12.9				
Bangladesh	39.5																39.5		39.5
Benin	102.1	34.4		102.1					102.1										
Bhutan	34.4																34.4		34.4
Bolivia	39.8									39.8	39.8								
Botswana	44.8	44.8					44.8	44.8											
Brazil	16.2									16.2					16.2				
Burkina Faso	92.4	92.4		92.4					92.4										
Burma/Myanmar	51.7																51.7	51.7	
Burundi	84.6	84.6	84.6			84.6													
Cambodia	30.6																30.6	30.6	
Cameroon	90.6	90.6			90.6														
Cape (Cabo) Verde	25.2	25.2		25.2															
Central African Republic	134	134			134														
Chad	142.9	142.9			142.9														
Colombia	16.4									16.4	16.4			16.4					
Comoros	75.9	75.9				75.9													
Congo, Dem. Rep	101.7	101.7			101.7														
Congo, Rep.	47.1	47.1				47.1													
Costa Rica	9.9									9.9		9.9	9.9						
Cote d'Ivoire	95.5	95.5		95.5					95.5										
Djibouti	67.4	67.4				67.4													
Ecuador	22.3									22.3	22.3								
El Salvador	17.4									17.4		17.4	17.4	17.4					
Ethiopia	61.8	61.8				61.8													
Gabon	52.3	52.3			52.3														
Gambia, The	71.1	71.1		71.1															
Ghana	64	64		64															
Guatemala	30.1									30.1			30.1	30.1					
Guinea	97	97		97	97														
Guinea-Bissau	96.2	96.2		96.2					96.2										
Honduras	21.1									21.1		21.1	21.1	21.1					
India	49.8																49.8		49.8
Indonesia	28.2																28.2	28.2	
Kenya	51.3	51.3	51.3			51.3													
Lao PDR	69.1																69.1	69.1	
Lesotho	92	92					92	92											
Liberia	72.9	72.9		72.9															
Madagascar	51.5	51.5				51.5		51.5											
Malawi	66.9	66.9				66.9		66.9											
Malaysia	7.2																7.2	7.2	
Mali	118.3	118.3		118.3					118.3										
Mauritius	13.9	13.9				13.9		13.9											
Mexico	13.8									13.8						13.8			
Mozambique	81.2	81.2						81.2											
Namibia	46.4	46.4					46.4	46.4											
Nepal	37.4																37.4		37.4
Nicaragua	22.8									22.8		22.8	22.8						
Nigeria	112.5	112.5		112.5															
Pakistan	83.3																83.3		83.3
Paraguay	21.2									21.2					21.2				
Peru	17.5									17.5	17.5								
Philippines	28.8																28.8	28.8	
Senegal	49.7	49.7		49.7					49.7										
Sierra Leone	126.4	126.4		126.4															
South Africa	41.4	41.4					41.4	41.4											
Sri Lanka	10																10		10
Sudan	72.2	72.2				72.2													
Swaziland	62.6	62.6				62.6	62.6	62.6											
Tanzania	50.5	50.5	50.5					50.5											
Thailand	12.6																12.6	12.6	
Togo	80.8	80.8		80.8					80.8										
Uganda	56.9	56.9	56.9			56.9													
Vietnam	22.3																22.3	22.3	
Zambia	66.6	66.6				66.6		66.6											
Zimbabwe	72.3	72.3				72.3		72.3											
Min	7.2	13.9	50.5	25.2	52.3	13.9	41.4	13.9	49.7	9.9	16.4	9.9	9.9	16.4	12.9	13.8	7.2	7.2	10
Mean	56.61343284	73.467	60.825	86.007	103.08	60.786	57.44	57.508	90.714	20.108	24	17.8	20.26	21.25	16.767	13.8	39.92	31.313	49.757
Median	51.5	71.1	54.1	93.95	99.35	64.6	46.4	57.05	95.5	17.5	19.9	19.25	21.1	19.25	16.2	13.8	34.4	28.5	39.5
Max	142.9	142.9	84.6	126.4	142.9	84.6	92	92	118.3	39.8	39.8	22.8	30.1	30.1	21.2	13.8	93.9	69.1	93.9
St Dev P	33.80209697	28.807	13.946	26.608	29.763	16.376	18.761	19.786	19.737	7.5496	9.388	4.9614	6.6256	5.4012	3.4121	0	24.888	18.95	27.119
St Dev S	34.05721076	29.183	16.104	27.613	32.603	16.994	20.976	20.666	21.319	7.8578	10.84	5.7289	7.4076	6.2367	4.1789		25.761	20.259	29.292
Counted		39	4	14	6	14	5	12	7	13	4	4	5	4	3	1	15	8	7
Missing			Rwanda	Niger		Egypt		Seychelle	Niger			Dominican Repiblic			Uruguay	Canada		Brunei-D	Maldives
						Eritrea									Venezuel	United States		Singapore	
						Libya													
						Rwanda													
						Seychelles													
Missing C.		0	1	1	0	5	0	1	1	0	0	1	0	0	2	2	0	2	1
Total C.		39	5	15	6	19	5	13	8	13	4	5	5	4	5	3	15	10	8

C.4 Descriptives based on Original Data (with Missings at Random)

Figure C.4.1: Summary Statistics for Dataset MAR

Variable		Mean	Std. Dev.	Min	Max	Observations
Childm~y	overall	92.38245	57.70352	7.2	264.3	N = 1675
	between		51.35767	10.444	213.124	n = 67
	within		27.01669	1.962448	185.7624	T = 25
Aggreg~n	overall	2.940896	2.550698	0	10	N = 1675
	between		2.047193	.32	8.4	n = 67
	within		1.541152	-5.459104	6.140896	T = 25
WTO	overall	.8161194	.3875025	0	1	N = 1675
	between		.3191701	0	1	n = 67
	within		.2230451	-.1438806	1.736119	T = 25
ICESCR	overall	1.633433	.7607956	0	2	N = 1675
	between		.6026848	0	2	n = 67
	within		.4698814	-.2865672	2.913433	T = 25
Polity	overall	.6289632	.2893837	0	1.35	N = 1659
	between		.2404448	.044	1	n = 67
	within		.1656656	-.0410368	1.690963	T-bar = 24.7612
RegimeD	overall	14.84031	17.6658	0	97	N = 1672
	between		15.04092	.52	83	n = 67
	within		9.428473	-40.11969	81.00031	T = 24.9552
Conflict	overall	.3703704	.8190005	0	7	N = 1647
	between		.7352318	0	4.68	n = 66
	within		.3750607	-2.30963	2.69037	T-bar = 24.9545
Nat_Di~r	overall	2.687761	3.5361	0	36	N = 1675
	between		2.950182	0	14.88	n = 67
	within		1.981214	-7.752239	24.24776	T = 25
GDP	overall	4420.324	4240.41	246.6705	23803.95	N = 1610
	between		4119.09	630.4552	17937.35	n = 65
	within		1089.12	-2166.526	11478.23	T-bar = 24.7692
GDPgr	overall	1.924011	5.295732	-50.23583	91.67289	N = 1632
	between		1.840736	-2.47023	5.533277	n = 66
	within		4.976347	-48.23835	93.67037	T-bar = 24.7273
Land	overall	43.65902	18.74565	7.192374	82.67134	N = 1608
	between		18.6724	8.211807	80.15639	n = 67
	within		2.780457	31.40726	59.78806	T = 24
Supply	overall	107.1609	12.16784	69	142	N = 1423
	between		10.96897	87.05	131.3478	n = 62
	within		5.495199	80.24788	131.2479	T-bar = 22.9516
FoodMe~h	overall	47.14596	111.2583	1	1180	N = 1425
	between		101.7817	2	656.5	n = 65
	within		46.2093	-244.354	579.646	T = 21.9231
RuralPop	overall	1.291291	1.412818	-7.723459	10.9086	N = 1675
	between		1.156052	-1.20639	3.585175	n = 67
	within		.8238685	-9.604491	9.027567	T = 25
Water	overall	72.12783	18.04871	13.2	100	N = 1653
	between		16.68434	32.852	99.424	n = 67
	within		7.072634	48.43183	99.12783	T-bar = 24.6716
Sanita~n	overall	42.15554	25.6048	2.6	96.1	N = 1642
	between		24.9793	10.076	91.996	n = 67
	within		6.077414	20.77459	71.17459	T-bar = 24.5075

Figure C.4.2: Pearson Correlation Matrix

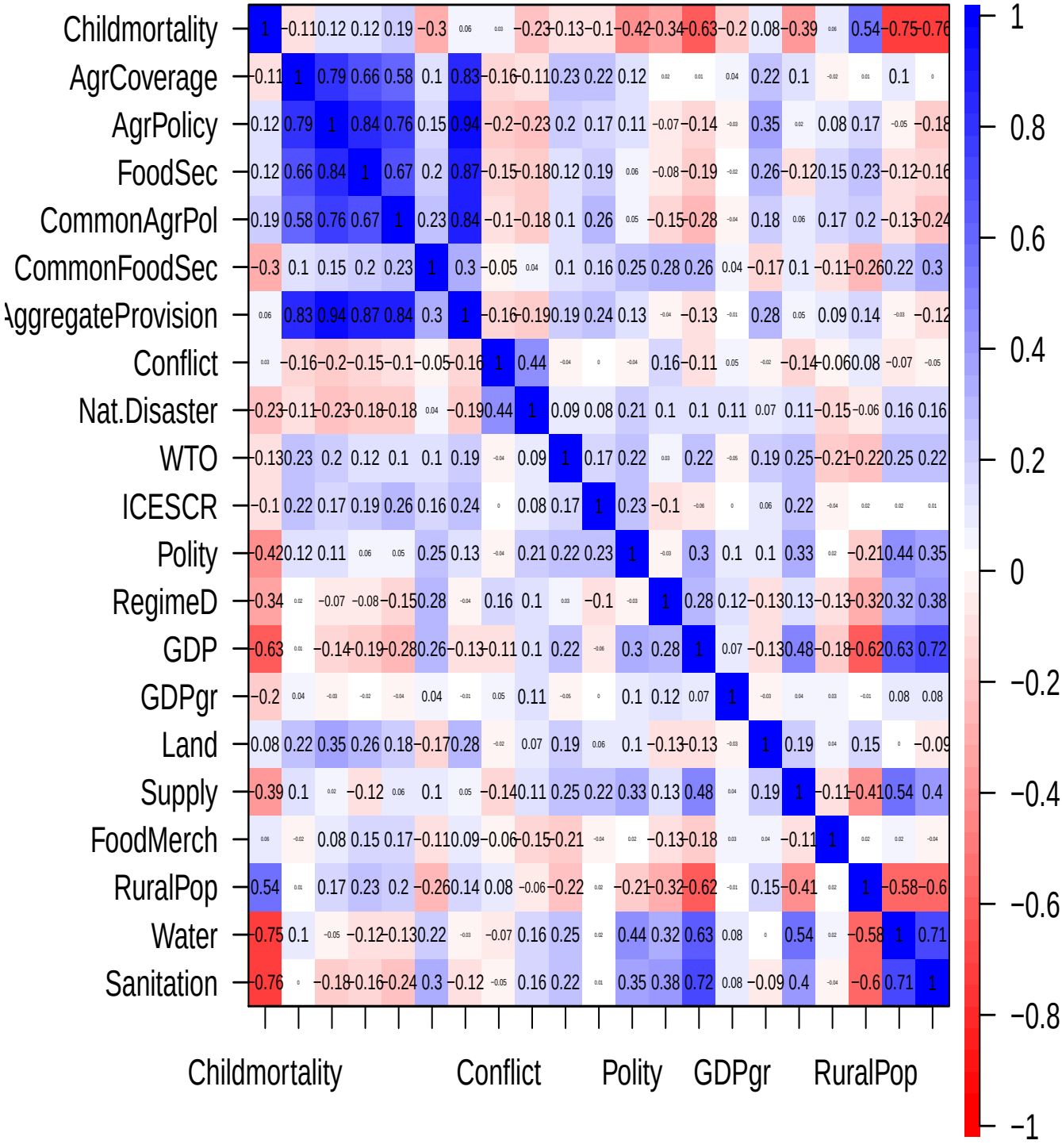
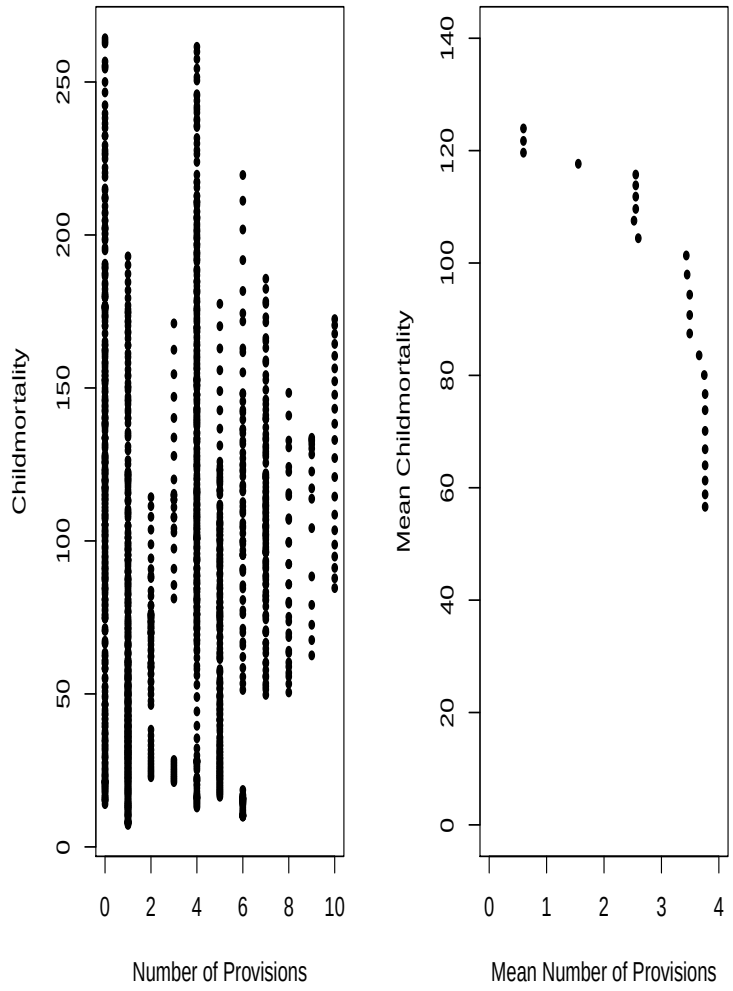


Figure C.4.3: Scatter Plots



C.5 Missing at Random and Multiple Imputation

The original dataset has about 5 percent (786/1675) missing observations (missing at random). In detail, following variables have following number of missings, listed in descending order and presented in Figure E.1: Supply (253), Food Imports overMerchandise Exports (FoMe) (251), Land (68), GDP (66), GDP growth (44), Sanitation (34), Conflict (29), Water (23), Polity (17), Regime Durability (RegimeD) (4).

Figure C.5.1: Pearson Correlation Matrix

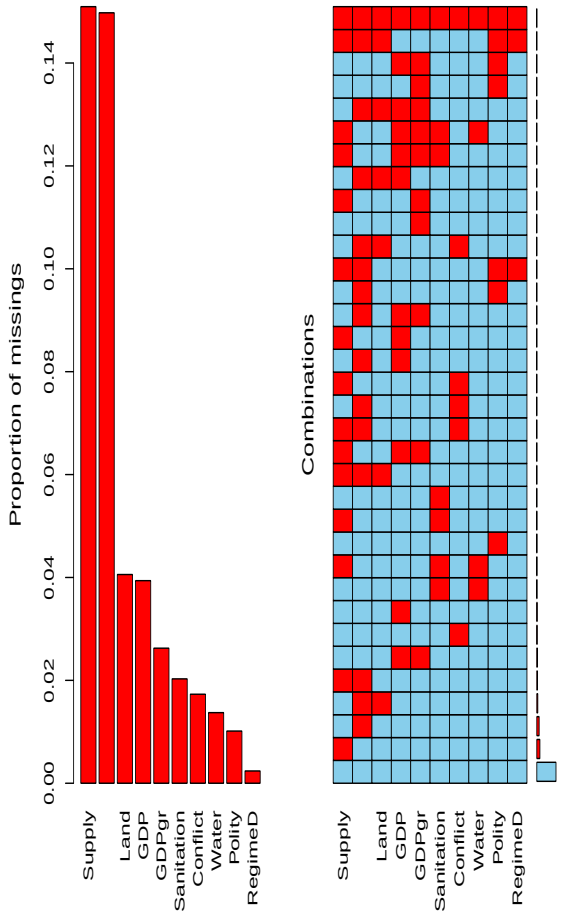
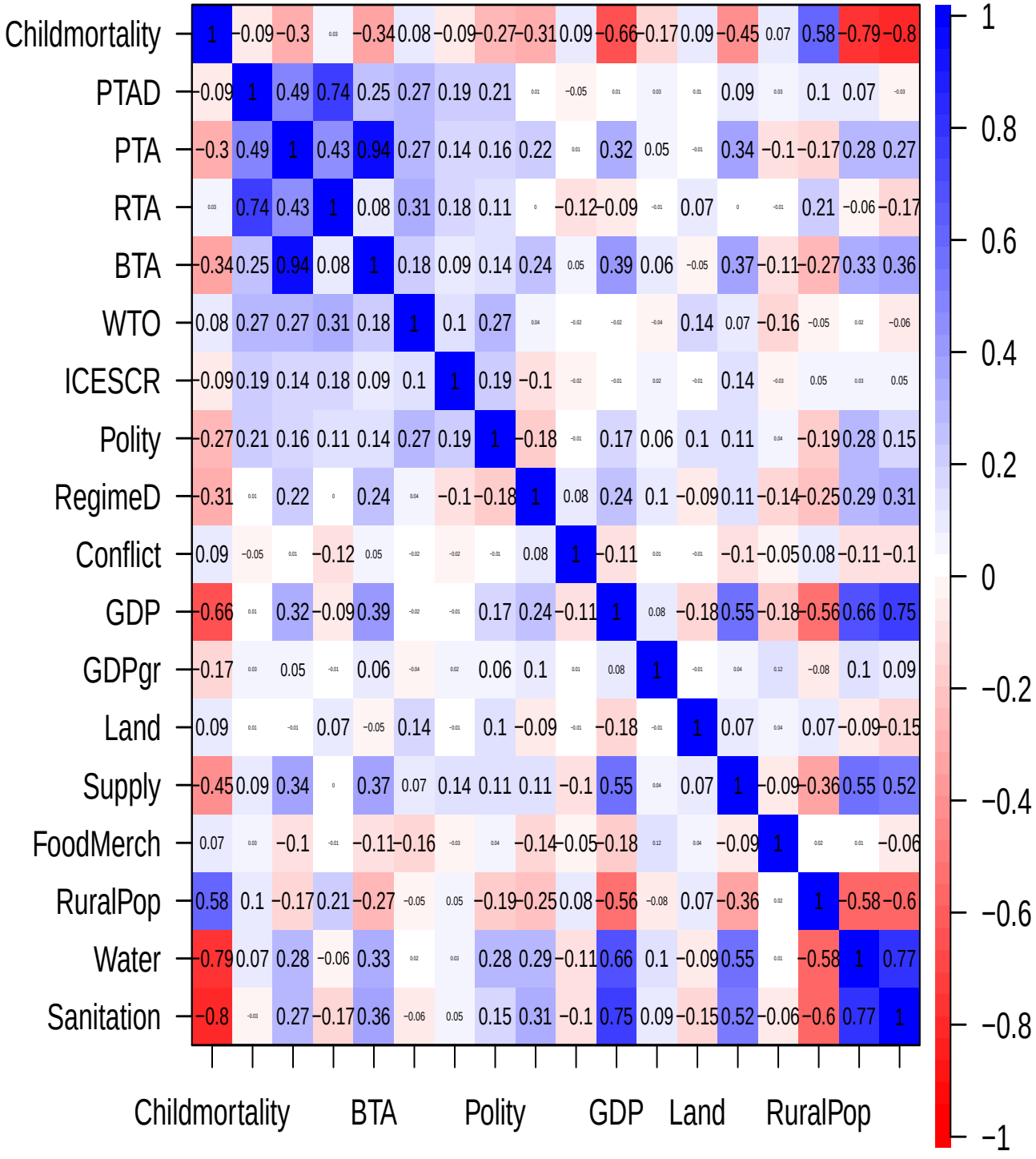


Figure C.5.2: Summary Statistics for Imputed Dataset

Variable		Mean	Std. Dev.	Min	Max	Observations	
Childm~y	overall	92.38245	57.70352	7.2	264.3	N =	1675
	between		51.35767	10.444	213.124	n =	67
	within		27.01669	1.962448	185.7624	T =	25
Aggreg~n	overall	2.940896	2.550698	0	10	N =	1675
	between		2.047193	.32	8.4	n =	67
	within		1.541152	-5.459104	6.140896	T =	25
WTO	overall	.8161194	.3875025	0	1	N =	1675
	between		.3191701	0	1	n =	67
	within		.2230451	-.1438806	1.736119	T =	25
ICESCR	overall	1.633433	.7607956	0	2	N =	1675
	between		.6026848	0	2	n =	67
	within		.4698814	-.2865672	2.913433	T =	25
Polity	overall	.6288672	.2881263	0	1.35	N =	1675
	between		.2366556	.044	1	n =	67
	within		.1667748	-.0411328	1.690867	T =	25
RegimeD	overall	14.83346	17.65087	0	97	N =	1675
	between		15.03255	.52	83	n =	67
	within		9.424196	-40.12654	80.99346	T =	25
Conflict	overall	.3888955	.826741	0	7	N =	1675
	between		.740712	0	4.68	n =	67
	within		.3777731	-2.291104	2.708896	T =	25
Nat_Di~r	overall	2.687761	3.5361	0	36	N =	1675
	between		2.950182	0	14.88	n =	67
	within		1.981214	-7.752239	24.24776	T =	25
GDP	overall	4545.391	4399.292	246.6705	23803.95	N =	1675
	between		4292.888	630.4552	17937.35	n =	67
	within		1090.454	-2041.459	11603.29	T =	25
GDPgr	overall	1.926142	5.230764	-50.23583	91.67289	N =	1675
	between		1.784118	-2.47023	5.484573	n =	67
	within		4.921733	-48.23622	93.6725	T =	25
Land	overall	43.74886	18.43008	7.192374	82.67134	N =	1675
	between		18.03019	9.174454	79.21613	n =	67
	within		4.386417	6.736094	77.19516	T =	25
Supply	overall	106.6142	11.69557	69	142	N =	1675
	between		10.18847	87.238	130.7596	n =	67
	within		5.871087	76.41902	132.0262	T =	25
FoodMe~h	overall	45.73936	104.4975	1	1180	N =	1675
	between		89.13238	2.7292	580.534	n =	67
	within		55.57917	-516.4346	645.2054	T =	25
RuralPop	overall	1.291291	1.412818	-7.723459	10.9086	N =	1675
	between		1.156052	-1.20639	3.585175	n =	67
	within		.8238685	-9.604491	9.027567	T =	25
Water	overall	72.01025	18.03455	13.2	100	N =	1675
	between		16.67599	32.852	99.424	n =	67
	within		7.151469	45.67789	99.01025	T =	25
Sanita~n	overall	41.942	25.49043	2.6	96.1	N =	1675
	between		24.84398	10.076	91.996	n =	67
	within		6.433317	10.86016	74.055	T =	25

Figure C.5.3: Pearson Correlation Matrix



C.6 List of Countries

Table C.6.1: List of 67 Low and Middle Income Countries

ID	Country	ID	Country
1	Afghanistan	39	Madagascar
2	Argentina	40	Malawi
3	Bangladesh	41	Malaysia
4	Benin	42	Mali
5	Bhutan	53	Mauritius
6	Bolivia	44	Mexico
7	Botswana	45	Mozambique
8	Brazil	46	Myanmar/Burma
9	Burkina Faso	47	Namibia
10	Burundi	48	Nepal
11	Cambodia	49	Nicaragua
12	Cameroon	50	Nigeria
13	Cape Verde	51	Pakistan
14	Central African Republic	52	Paraguay
15	Chad	53	Peru
16	Colombia	54	Philippines
17	Comoros	55	Senegal
18	Dem. Rep. Congo	56	Sierra Leone
19	Rep. Congo	57	South Africa
20	Costa Rica	58	Sri Lanka
21	Cote d'Ivoire	59	Sudan
22	Djibouti	60	Swaziland
23	Ecuador	61	Tanzania
24	El Salvador	62	Thailand
25	Ethiopia	63	Togo
26	Gabon	64	Uganda
27	Gambia	65	Vietnam
28	Ghana	66	Zambia
29	Guatemala	67	Zimbabwe
30	Guinea		
31	Guinea-Bissau		
32	Honduras		
33	India		
34	Indonesia		
35	Kenya		
36	Laos		
37	Lesotho		
38	Liberia		