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FACULTY OF SOCIAL AND HUMAN SCIENCES

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Urbanisation and inequalities in a post-Malthusian context: implications for theory and policy

by

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ABSTRACT

FACULTY OF SOCIAL AND HUMAN SCIENCES

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URBANISATION AND INEQUALITIES IN A POST-MALTHUSIAN CONTEXT: IMPLICATIONS FOR THEORY AND POLICY

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The phenomenon of rapid global urbanisation, urban trends and processes have recently become a topic of increased scholarly inquiry. Yet, little attention has been paid to how urbanisation fits within the post-Malthusian framework and how it affects the most basic resources essential for human survival. By attempting to fill this gap, this thesis contributes, both conceptually and empirically, to the current body of literature on population and development. The thesis is composed of three stand-alone yet interconnected papers (Chapters 3-5), each addressing a set of distinct research problems and questions. Each paper uses a separate dataset developed for the purpose of the study, analysed by means of regression modelling. While anchored in the Malthusian and post-Malthusian literature, all papers are supplemented by additional theoretical and conceptual lines of thought, thus aiming to adapt a holistic approach.

Paper One seeks to reorient the Malthusian theory by proposing an initial post-Malthusian framework with a focus on the urbanisation-food security nexus. The quantitative analysis of country-level data confirms that urban growth has a significant negative impact on food security and that the strength of this association is altered by the human development context. In particular, countries' education has been found to have a significant attenuating effect on the relationship between urban growth and food insecurity risk. The research questions in Paper Two have been motivated by the Simonian arguments related to the power of human capital in overcoming challenges presented by population growth. The paper tests five interrelated hypotheses pertaining to the impacts of urbanisation on households' access to safe drinking water in the least developed countries (LDCs), as well as the presumed mitigating impact of human capital on these associations. The results show a differential effect of urbanisation on water access, which is moderated by households' human capital. Finally, Paper Three aims to examine intra-urban inequalities in children's nutritional outcomes in selected LDCs experiencing different pace of urbanisation. The results confirm that most rapidly urbanising LDCs suffer from greater intra-urban inequalities, which are exacerbated by parents' lack of education. In addition, mother's socio-economic characteristics and child's birth weight are confirmed to be significant predictors of child undernutrition.

Overall, this research highlights that the Malthusian theory remains a relevant source of inspiration for contemporary population and development studies; in particular with reference to investigating the determinants of basic necessities, such as food and water. Inasmuch, the revised post-Malthusian framework can constitute a useful basis for future empirical studies and policymaking which deal with practical challenges resulting from global urbanisation processes.

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DECLARATION OF AUTHORSHIP

I, Sylvia Szabo

declare that the thesis entitled

'Urbanisation and inequalities in a post-Malthusian context: implications for theory and policy.'

and the work presented in the thesis are both my own, and have been generated by me as the result of my own original research. I confirm that:

- this work was done wholly or mainly while in candidature for a research degree at this University;
- where any part of this thesis has previously been submitted for a degree or any other qualification at this University or any other institution, this has been clearly stated;
- where I have consulted the published work of others, this is always clearly attributed;
- where I have quoted from the work of others, the source is always given. With the exception of such quotations, this thesis is entirely my own work;
- I have acknowledged all main sources of help;
- where the thesis is based on work done by myself jointly with others, I have made clear exactly what was done by others and what I have contributed myself;
- none of this work has been published before submission.

Signed: …………………………………………………………………………..

Date: ……………………………………………………………………………

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LIST OF ACRONYMS

ADB	Asian Development Bank
AI	Assets Index
ANOVA	Analysis of Variance
ART	Antiretroviral therapy (-ies)
ASEAN	Association of Southeast Asian Nations
BMI	Body Mass Index
CGIAR	Consultative Group on International Agricultural Research
CIESIN	Center for International Earth Science Information Network
CPS	Current Population Survey
DHS	Demographic and Health Survey(s)
EU	European Union
FAO	Food and Agriculture Organization of the United Nations
FIRI	Food Insecurity Risk Index
GCC	Gulf Cooperation Council
GDP	Gross Domestic Product
GFATM	The Global Fund to Fight AIDS, Tuberculosis and Malaria
GHO	Global Health Observatory
GMO	Genetically Modified Organisms
GNI	Gross National Income
GLAAS	Global Analysis and Assessment of Sanitation and Drinking-Water (WHO/UN-Water)
GWSP	Global Water System Project
HC	Human capital

HDI	Human Development Index or Human Development Indicators
HPB	Health Promotion Board (Singapore)
ICLEI	International Council for Local Environmental Initiatives
IFAD	International Fund for Agriculture Development
IFPRI	International Food Policy Research Institute
IFRCRCS	International Federation of Red Cross and Red Crescent Societies
IFS	Informal food sector
IIED	International Institute for Environment and Development
IISD	International Institute for Sustainable Development
IOM	International Organization for Migration
ICT	Information and communications technology
ITU	International Telecommunications Union
IMR	UN-Water Task Force on Indicators, Monitoring and Reporting
IWS	Improved water source(s)
JMP	Joint Monitoring Programme for Water Supply and Sanitation (WHO/UNICEF)
LAC	Latin America and the Caribbean
LDC	Least developed country
MAF	Millennium Development Goals (MDG) Acceleration Framework
MDG	Millennium Development Goal(s)
MTF	Malthusian Theoretical Framework
MWCD	Ministry of Women and Child Development (Government of India)
NGO	Non-governmental organisation
ODA	Official development assistance (or aid)

OECD	Organisation for Economic Co-operation and Development
PCA	Principal Components Analysis
PPWSA	Phnom Pen Water Supply Authority
R&D	Research and development
SDSN	Sustainable Development Solutions Network - A Global Initiative for the United Nations
SDW	Safe drinking water
SLF	Sustainable Livelihoods Framework
TFR	Total Fertility Rate
UBT	Urban Bias Theory
UFW	Unaccounted-for Water
UNECOSOC	United Nations Economic and Social Council
UN	United Nations
UN-HABITAT	United Nations Human Settlements Programme
UNCTAD	United Nations Conference on Trade and Development
UN DESA	United Nations Department of Economic and Social Affairs
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNESCAP	United Nations Economic and Social Commission for Asia and the Pacific
UNESCO	United Nations Educational, Scientific and Cultural Organisation
UNESCWA	United Nations Economic and Social Commission for Western Asia
UNICEF	United Nations Children's Fund
USAID	United States Agency for International Development

USDA	United States Department of Agriculture
WB	World Bank
WDI	World Development Indicators
WFP	United Nations World Food Programme
WGI	Worldwide Governance Indicators
WHO	World Health Organization
WWAP	The United Nations World Water Assessment Program

CHAPTER 1 INTRODUCTION

"I think I may fairly make two postulata. First, that food is necessary to the existence of man. Secondly, that the passion between the sexes is necessary, and will remain nearly in its present state" (Malthus, 1798, p.8).

"That population cannot increase without the means of subsistence, is a proposition so evident, that it needs no illustration. That population does invariably increase, where there are the means of subsistence, the history of every people that have ever existed will abundantly prove. And, that the superior power of population cannot be checked, without producing misery or vice, the ample portion of these two bitter ingredients in the cup of human life, and the continuance/of the physical causes that seem to have produced them, bear to convincing a testimony" (Malthus, 1798, p.17).

1.1 Background

This thesis has been motivated by the traditional Malthusian debate on population growth and the availability of the means of subsistence. The Malthusian debate has not only survived throughout time, but could be argued to have become even more relevant as the world's population has been experiencing unprecedented growth. With the total population exceeding 7 billion, the potential Malthusian risks have never appeared more pertinent. At the same time, the current developmental discussion continues to focus on population growth as a key barrier to achieving a high level of human development and enhancing the quality of life (Sachs, 2002; Cleland & Sinding, 2005; House of Commons, 2007; Sachs, 2009; Bongaarts & Sinding, 2011; FAO, 2013a; SDSN, 2013). Population control programmes are being implemented around the world and governments and UN agencies periodically announce new achievements in family planning. Given the disquieting spread of hunger, a recent report by the Food and Agricultural Organization of the United Nations (FAO) recommended that edible insects should be adapted more broadly as part of the human diet (FAO, 2013a).

This thesis develops an argument that in an era of rapid urbanisation coupled with technological advancements resulting from the continuously increasing power of human capital, a population-centric approach is outdated. Thus, the primary tenet of this thesis is that, in order to remain relevant, the Malthusian theoretical framework (MTF) has to be reconceptualised, so as to serve as a useful tool in identifying and tackling the contemporary challenges related to securing households' means of subsistence. The thesis argues that a traditional population-based outlook has at least two major pitfalls. First, it disregards other key factors, such as urbanisation, which have a significant impact on food demand, agricultural supply, and the availability of and access to quality food and safe drinking water. Second, by focusing on the issue of population growth, the neo-Malthusian logic neglects the need to redirect our attention from confounders to key outcome variables. Over centuries, the population has continued to grow, yet today's world benefits from the highest levels of quality of life witnessed in human history (Zlotnik, 2011). On the other hand, numerous countries, such as Vietnam and Moldova, continue to face developmental challenges, although their total fertility rates are below replacement level. At the same time, while poverty and inequalities continue to persist in different geographical settings, their nature has evolved. In many countries, including in sub-Saharan Africa, traditional positive checks acting at the mortality level are predominant in rural areas, where overall life expectancy is lower (Hanna & Hanna, 2009). Although separate studies have addressed questions of the impact of urbanisation on the provision of food and water, to the best of the author's knowledge, limited research in this area has been conducted in the context of the Malthusian theory and subsequent post-Malthusian debate.

In 1798 Malthus made two central postulata which, along with other socio-demographic claims, became the tenets of his famous theory. These postulata read that 1) "food is necessary to the existence of man", and that 2) "the passion between the sexes is necessary, and will remain nearly in its present state" (Malthus, 1798, p.8). While it is difficult to refute these assumptions, the aim of this thesis is to complement the Malthusian postulata with a set of supplementary propositions taking into account the current global demographic and developmental situation. Consequently, this thesis proposes and investigates the following additional postulata:

1) Urban factors, such as urban place of residence and urban growth rates have a significant impact on vital resources, including food. The impact of urbanisation on food security depends on a country-specific human development context.

2) Human capital has a considerable mitigating effect on households' subsistence. Its impact on access to basic necessities, such safe drinking water, varies depending on the nature and scope of urbanisation and the initial developmental setting.

3) Poverty and inequality are not a direct consequence of population growth as they exist in different demographic and spatial contexts. Within-urban inequalities have become a new developmental challenge and exacerbate traditional inequality causes (e.g. income) and differentials (e.g. rural-urban).

Each chapter of this thesis aims at investigating one of the above-mentioned postulata so as to enable conceptualisation of a contemporary evidence-based post-Malthusian framework. In the 21st century, risks related to securing vital resources continue to exist and in many cases result in hunger and death. The word "vital", from the Latin "vita", is used to stress the focus on the resources that are necessary to human life. The Malthusian arguments are strongly related to contemporary challenges, which result in misery, poverty and inequality. While the proportion of people in developing countries who suffer from hunger has decreased, it is still as high as 15 per cent (UN, 2013b). Around 870 million people do not consume enough food to satisfy their energy requirements, an increase from 837 million between 2006 and 2008 (United Nations, 2012; UN, 2013b). Many countries, particularly in sub-Saharan Africa, are off track when it comes to their goals of hunger reduction. At the same time, contemporary food-related challenges go beyond the issues related to hunger and malnutrition, thus calling for a new approach. This thesis addresses the evolving reality not only by investigating the underlying associations between urbanisation and present-day food security, but also by re-assessing the concept of food insecurity itself.

The specific focus of the thesis is on global urbanisation processes and inequalities in access to food and water, in particular in the context of rapid urbanisation. The thesis does not explicitly address the role of international trade, food distribution, consumer demand and local and international politics. When relevant, however, issues pertaining to consumption patterns and trade related inequalities, such as the agrarian paradox, are mentioned.

In many countries, concurrently to food-related challenges, access to safe drinking water remains a key developmental obstacle. Most countries are projected to exceed their targets related to improved water access. Yet, between 1990 and 2008, in 13 countries the proportion of those having access to safe drinking water declined (United Nations, 2012). While, overall, rural areas tend to lag behind cities in terms of benefiting from access to safe drinking water, within urban areas inequalities are on the rise. In sub-Saharan Africa the poorest segment of the urban population is six times less likely to benefit from access to an improved water source as compared to the richest households (United Nations, 2011a). Given the timescale, the contribution of this thesis is situated in the context of the post-MDGs agenda and longer-term developmental objectives.

1.2 Scientific contribution and objectives of the thesis

As highlighted previously, the overarching aim of this thesis is to reorient the Malthusian debate and propose a novel evidence-based post-Malthusian framework with a focus on contemporary urban processes. By doing so, the author's objective is to contribute not only to the current body of literature, but also to a better understanding of practical issues pertaining to the most basic requirements for human development. Hence, the research questions in this thesis are formulated in such a way as to enable further understanding of underlying conceptual challenges. The hypotheses and quantitative analyses complement the discussion by identifying a concrete set of opportunities based on empirical findings. By adapting this integrated approach, the thesis aims to make both a substantive and a conceptual contribution. In addition, the thesis is intended to offer policy guidance to development practitioners and policymakers. Methodologically, the thesis takes advantage of both macro-level and micro-level datasets, as outlined in section 1.4. In conclusion, the broad objectives of this thesis can be summarised as follows:

1) To reorient the post-Malthusian debate in the context of contemporary urbanisation;
2) To propose a revisited conceptual framework based on the traditional Malthusian theory;
3) To contribute to the existing body of research in the area of population and development;
4) To investigate the interlinkages between urbanisation and inequalities in access to safe drinking water and food;
5) To constitute policy advisory in the context of the post-MDG agenda.

1.3 Research questions

This thesis investigates issues of global relevance, with a sustained focus on examining the direct and indirect associations between urbanisation and inequalities in access to vital resources. Chapter 4, for instance, focuses on the mitigating role of human capital on the relationship between urbanisation and households' access to safe drinking water. It would be difficult to argue against the fact that food and water constitute the foundation of human livelihoods, as simply no life can exist without them. Throughout this thesis, terms "key resources", "vital resources", and "means of subsistence" are considered to be semantically the same, and used interchangeably. The research in this thesis is guided by three overarching questions, which have been motivated by the original Malthusian framework as well as contemporary developmental obstacles. These are:

- **RQ1:** What is the impact of urbanisation on the access to and availability of vital resources at the macro and micro level?

- **RQ2:** How does human capital influence the effect of urban factors on access to vital resources?

- **RQ3**: What is the extent of intra-urban inequalities in access to basic means of subsistence?

More specifically, each empirical chapter addresses a set of key targeted research questions complemented by research hypotheses, which are then tested by means of quantitative analysis. Thus, Chapter 3 focuses on investigating country-level association between urban growth and food insecurity risk and asks how this association is moderated by countries' level of development. Chapter 4 examines the direct relationship between urbanisation and access to safe drinking water, as well as the presumed mitigating effect of human capital on this association. Based on the arguments developed by Simon (1981) and Boserup (1981; 1993), the hypotheses and propositions in Chapter 4 assume a powerful role for human capital in the least developed countries (LDCs). Finally, Chapter 5 investigates the extent of intra-urban inequalities in children's nutritional outcomes in most rapidly and less rapidly urbanising LDCs. The research in this chapter draws from the Malthusian arguments regarding societal inequalities and a growing body of literature on contemporary inequalities linked to rapid urbanisation.

While empirical analysis starts by exploring associations at the global level (Chapter 3), Chapters 4 and 5 use micro-level data to examine household-level and individual-level relationships. Each chapter outlines specific research questions and hypotheses and provides a brief overview of their structures. Both Chapter 4 and Chapter 5 focus on the analysis of the LDCs. As highlighted by the United Nations, the LDC group has been created to address the special needs of the most vulnerable nations (UNCTAD, 2011) and thus requires particular research efforts. The full list of LDCs in provided in Appendix A. A summary of all research questions is presented in Table 1.1, while the summary of the data sources used in the thesis is discussed in the next section.

Table 1.1 Summary of research questions.

Chapter	**Type of RQ**	**Research questions**
CH3: Urbanisation and food insecurity: The role of human development in a post-Malthusian framework.	Overarching	What is the impact of urbanisation on the access to and availability of vital resources at the macro level?
	Specific	What is the nature of the association between urbanisation and food insecurity in contemporary societies? How does the level of human development influence the association between urbanisation and food insecurity?
CH4: Does urbanisation increase households' access to safe drinking water? Disentangling the role of human capital in a post-Malthusian context.	Overarching	How does human capital influence the effect of urban growth and place of residence on access to vital resources?
	Specific	What is the relationship between urbanisation and access to safe water for households in least developed countries? Does human capital have a moderating effect on this association? To what extent household characteristics and contextual factors impact access to safe drinking water?
CH5: Is rapid urbanisation exacerbating intra-urban inequalities in nutritional outcomes? Evidence from the least developed countries.	Overarching	What is the extent of intra-urban inequalities in access to basic means of subsistence?
	Specific	What is the extent of intra-urban inequalities in children's nutritional outcomes in LDCs? Do these inequality patterns vary between countries which experience more rapid and less rapid pace of urbanisation? What is the impact of confounding factors, such as mother's socio-economic characteristics and child's birth weight?

1.4 Data sources

While the details of data and methods are described in each empirical chapter, the objective of this section is to provide a brief summary of data sources and methodology. Thus, Paper One (Chapter 3) uses primarily macro-level data, although micro data analysis[1] has been conducted and its results are briefly discussed in Box 3.1. Aggregate data, which are mainly drawn from the databases of international agencies, such the UN and the World Bank (WB), are analysed using heterogeneous choice models (Williams, 2009, 2010).

Paper Two (Chapter 4) uses a pooled dataset of 19 Demographic and Health Survey (DHS) data, for which fieldwork took place between 2000 and 2010 (waves 5 and 6). The dataset is complemented by aggregate-level data drawn from the UN and the WB. Descriptive statistics include cross-tabulations and Kruskal-Wallis tests, which are carried out on a full sample and sub-sample of the data. The sub-sample uses all available data pertaining to specific type of residence (large city, small city, town and countryside)[2]. Multilevel logistic regression is applied because the response variable is binary (safe drinking water vs. unsafe drinking water) and because the aim of the research is to account for presupposed country effects. As in all regression modelling, data are screened for potential multicollinearity and outliers are removed.

Finally, Paper Three (Chapter 5) uses two separate DHS datasets from the five most rapidly and five less rapidly urbanising LDCs. More specifically, the selected countries comprise Burkina Faso, Burundi, Mozambique, Nepal, Rwanda (most rapidly urbanising countries) and Congo (DRC), Niger, Senegal, Sierra Leone and Zambia (less rapidly urbanising countries). Methodologically, the paper makes use of commonly applied inequality measures, such as ratios, concentration indices and concentration curves. As in Paper Two, given the binary nature of the response variable, the analysis is based on fixed effects logistic regression modelling. A summary of data and methods used in the study is provided in Table 1.2. The overall organisation of the thesis is discussed in the next section.

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[1] Micro-level data originate from India's 2005-06 Demographic and Health Survey (DHS). The female dataset is used in the analysis as females tend to be subject to widely spread discrimination and as such are more prone to suffer from food insecurity risks.

[2] Throughout the thesis a distinction is made between "place of residence" and "type of residence". The former refers to urban vs. rural, while the latter involves a greater degree of disaggregation and encompasses large cities, small; cities, towns and countryside.

Table 1.2 Summary of data sources and methods.

Chapter	Level of analysis	Data sources	Method of analysis
CH3: Urbanisation and Food Insecurity: The role of Human Development in a post-Malthusian framework.	Macro level	Combined dataset of macro-level statistics from the WDI, WHO, UN Population Prospects, UN Urbanisation Prospects and Emergency Disasters Database (EM-DAT).	Descriptive statistics & heterogeneous choice modelling.
CH4: Does urbanisation increase households' access to safe drinking water? Disentangling the role of human capital in a post-Malthusian context.	Household level	Combined dataset of 19 individual DHS datasets with surveys conducted between 2000 and 2010 (waves 5 & 6).	Descriptive statistics & multilevel logistic regression.
CH5: Is rapid urbanisation exacerbating intra-urban inequalities in nutritional outcomes? Evidence from the least developed countries.	Individual level (child)	Two pooled DHS dataset of 5 countries each. All datasets are between 2005 and 2012. Child-level datasets.	Descriptive statistics, inequality measures (ratios, concentration indices, concentration curves) & logistic regression.

1.5 Structure of the thesis

This thesis contains six chapters. Each empirical chapter (Chapters 3-5) can be read as a related yet stand-alone paper and as such it contributes to a specific area of study. Chapter 1 serves as an overall introduction and roadmap to the thesis. In Chapter 2, the focus is on highlighting and discussing the research problem, the original Malthusian framework and key background literature. In addition, Chapter 2 provides a brief overview of historical and recent trends in urbanisation and discusses issues related to the geneses and definitions of urbanisation. A new typology of urbanisation is also proposed. In Chapters 3 to 5, a detailed discussion and analysis addressing the specific research questions is undertaken. These chapters provide empirical evidence and allow final conclusions.

In particular, Chapter 3 offers novel approaches to the analysis of the relationship between urbanisation and food security at the country-level and focuses on developmental differentials which are assumed to affect this relationship. Additionally, Chapter 3 suggests a revised interpretation and measurement of contemporary food insecurity and proposes a new food insecurity risk index which is used in the regression modelling. The emphasis of Chapter 4 is on the impact of different urban factors on access to safe drinking water as well as on another key area of post-Malthusian research, i.e. human capital. In this context, Chapter 4 delivers a household-level and cross-level analysis regarding the mitigating impact of households' human capital. Because the subject of this thesis is situated within the debate and policy pertaining to international development, the analysis focuses on the least developed countries. As highlighted previously, the last empirical chapter, Chapter 5, investigates the extent of intra-urban inequalities in children's nutritional outcomes in the LDCs which have been experiencing different pace of urbanisation. Using two separate datasets, Chapter 5 discusses the evolving nature of these inequalities accounting for both demographic and socio-economic factors. Finally, Chapter 6 provides overall conclusions of the entire study, comprising a summary of key findings, a revised post-Malthusian framework and a brief discussion of policy implications. A section on the planned research agenda resulting from the work in this thesis is also included. Throughout this study, different levels of analysis are used based on the research questions and data availability. The limitations of this research are outlined in Chapter 6 as well as in the individual empirical chapters.

CHAPTER 2 BACKGROUND

"Cities are where the battle for sustainable development will be won or lost" (United Nations, 2013a, p. 17).

2.1 Introduction

Where people live, or otherwise human settlements, cannot be considered as a factor explaining demographic behaviour without accounting for its ampler consequences (Champion & Hugo, 2004). Dyson (2011) argued that urbanisation understood as the change of the place of residence is both an outcome and a component of demographic transition and plays a role in all its key stages. While this is a convincing argument, it remains contestable that rapid urbanisation "must be seen in the context of rapid population growth" (Dyson, 2011, p.47). Although urbanisation is a result of demographic processes, as it is difficult to account for urban trends without referring back to the three components of demographic change, urbanisation cannot be conceptualised solely from the perspective of population growth.

Without doubt, the origins of urbanisation are complex. While in parts of Asia, urbanisation is primarily thought of as a consequence of natural population increase (Dutt et al., 1994), in Europe and Africa the origins of urbanisation differ. In Europe, for example, urbanisation is generally linked to industrialisation processes, while in Africa, colonial settlements are thought to have contributed to the increasing urbanisation of the continent. The geneses of urbanisation will be discussed in more detailed later in section 2.3 of this chapter. It is, however, important to stress at the outset of this thesis that the definition of urbanisation should not be restricted by the relation between natural increase in population size and urban growth. Crucially, the nature and scope of urbanisation have important implications when it comes to people's concerns in terms of ensuring human survival. Thus, despite the changing nature of the underlying associations, the Malthusian threats remain an important contemporary issue. In this context, urbanisation outcomes including improved infrastructure in towns and cities often facilitate households' access to key amenities. On the other hand, urbanisation is likely to have a negative impact on environment, and thus people's access to safe drinking water and nutritional outcomes.

In light of the above, the purpose of this chapter is threefold. Firstly, it provides a concise overview of urban origins, past and current trends in urbanisation, as well as a discussion regarding the definitional and measurement challenges pertaining to urbanisation. Secondly, it familiarises the reader with the basic tenets of Malthusian theory, highlighting both its relevance and the need to reorient its sole focus on population growth. Thirdly, in order to revisit the Malthusian theory, the chapter discusses the key background literature, which includes the post-Malthusian literature as well as human capital theory and theories originating from urban studies. References to empirical evidence are provided throughout the chapter.

2.2 Theoretical background and key literature

2.2.1 The original Malthusian framework

The overarching research questions in this thesis have been motivated by the arguments in the *Essay on the Principle of Population* by Thomas R. Malthus and the related work conducted by his contemporaries, in particular William Godwin and Marquis de Condorcet. While both these thinkers advocated a progression towards an idealistic society, Malthus claimed that the outlook for the future of the world's population was bleak. A very simplistic, yet key assumption of the Malthusian theoretical framework (Figure 2.1) is the hypothesis that population grows at a geometrical ratio, while resources increase arithmetically. It was therefore inevitable that at certain stages populations, if unchecked, would outgrow their means of subsistence. Providing the example of the United Kingdom ("The Island"), Malthus argued that a hundred years later (1898), the population of the country would reach 112 million people, while the means of subsistence would be able to support only 35 million people (Malthus, 1798, p.13). Malthus recognised, however, that population does not grow at an equal pace in all countries. He acknowledged that there were certain countries where population was stationary or even declining.

As a general law, however, Malthus assumed that population growth was regulated in two ways, i.e. by the preventive checks and by the positive checks. In England, for example, the operation of preventive checks hampered to a large extent the natural propensity of a population to grow. Frightened by potential expenses that a husband would have to endure, as well as the need to give up "the fancied pleasures", many young men renounced marriage. Malthus claimed that "The labourer who earns eighteen pence a day, and lives with some degree of comfort as a single man, will hesitate a little before he divided that pittance among four or five" (Malthus, 1798, p.91). These 18th century preventive checks, which related to Adam Smith's economic theory of rational choice, have never been more relevant than they are today. The importance of maintaining a certain standard of living and economic well-being, individualism and reluctance to accept responsibilities, combined with an unfavourable economic climate are currently amongst the main factors explaining declining fertility rates worldwide. Today, fertility decline and increasing global fertility convergence constitute key areas of demographic research and a focus of policy planning (Kohler et al., 2002; Wilson, 2011). Although often forgotten, the Malthusian contribution to the demographic transition theory is one of the greatest and longest lasting achievements of the MTF.

Related to the idea of preventive checks is the Malthusian assumption of constant passion between the sexes, which is one of the key tenets of his theory. In this context, Malthus disagreed with Godwin, who claimed that in a perfect society passion between the sexes would be extinguished (Sandmo, 2010). Both thinkers understood the danger of a utopian equal society advocated by Godwin, as being propitious to population growth. However, Godwin argued that in an equal society the solution to the potential population growth lay in the assumption that passion between the sexes would cease. A strong proponent of the power of knowledge, Godwin believed in "the eclipsing of the desire for sex by the development of intellectual pleasures" (Medema & Samuels, 2003, p.208). One might argue that there is a certain degree of plausibility in terms of potential weakening of passion between the sexes. This is, however, likely not due to the "development of intellectual pleasures", but rather to the stress and lack of spare time associated with working patterns in many contemporary societies. According to a survey conducted by the Ministry of Health, Labour, and Welfare and the Japan Family Planning Association, around 35 per cent of all the married couples in Japan are "sexless" (Kawakami, 2007). This finding was explained mainly by long working hours which cause tiredness, post-partum abstinence and considering sex as "too troublesome"(Moriki, 2012, p.4).

Malthusian positive checks, on the other hand, are those that affect death rates, and as such act primarily amongst the lowest classes of the society. These include famine, wars, natural disasters, but also consequences of being exposed to hard labour and difficult living conditions. In China, although early marriage was popular, famine and the custom of abandoning one's child, or "exposing children" (Malthus, 1798, p.25) kept the population in check. One could argue that positive checks are equally relevant today. In the contemporary Chinese society, population control has taken the form of the one child policy, which triggered sex-selective induced abortion and male preference. Overall, populations without access to health services and nutrition are at much higher risk of disease and death. Across the globe, military conflicts and war generally occur in poor countries. For example, war-torn Afghanistan and Democratic Republic of Congo (DRC) experience a crude death rate (CDR) of 19.22 and 16.79, respectively (UN, 2010). On the other hand, however, research has shown that in conflict-torn countries fertility tends to pick up because of the so-called replacement effect. For example, evidence from Rwanda suggests that the genocide had a strong impact on fertility increase related to the loss of children (Schindler & Brück, 2011).

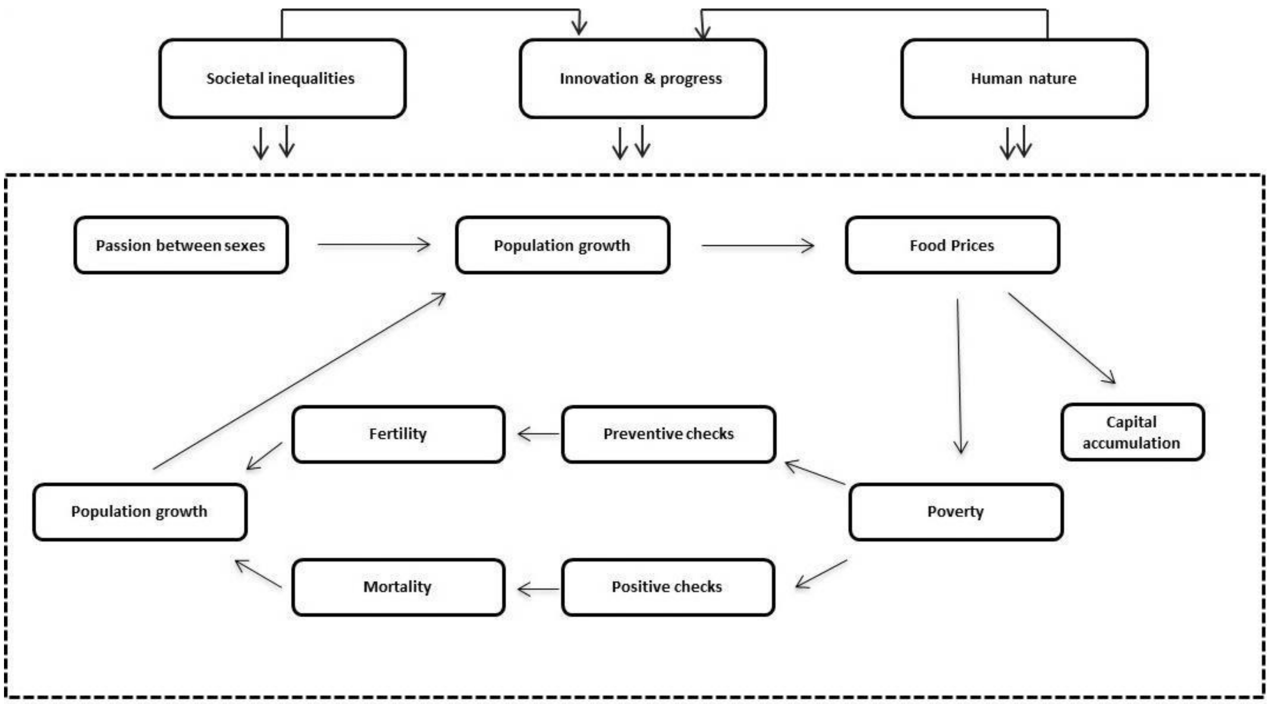

Figure 2.1 Malthusian conceptual framework (adapted from Malthus, 1798; 1826).

One of the key tenets of Malthusian theory, although often omitted in demographic literature, is Malthus' stress on inequalities. Societal inequalities, in Malthus' view, were a natural part of human organisation. Malthus compared the existence of inequalities to the distribution of different elements of nature or naturally occurring phenomena. Thus, he argued that, like a tree consists of roots and branches, so a society needs to be diversified (Malthus, 1798). While Malthus acknowledged that ideally the largest possible part of a society should be constituted of a middle class, he warned that a tendency to move towards the middle of a distribution could only exist within limits. At the heart of Malthusian arguments against an egalitarian society advocated by Condorcet and Godwin lay Malthus' underlying claim that "misery and the fear of misery" were the causes of population being kept in check. In the spirit of Hobbes' views on human nature, Malthus (1826, p.334) argued that in conditions of scarcity "the spirit of benevolence, cherished and invigorated by plenty, is repressed by chilling breath of want". Thus, he rejected a possibility of an egalitarian society based on a presumption that ultimately the need to satisfy the requirements for basic means of subsistence would overtake any intellectual or spiritual aims.

Another important aspect of the Malthusian outlook regarding inequalities was his claim that societal inequalities stimulate innovation. Because people aim to improve their conditions, they are compelled to "a greater quantity of exertion", which stimulates new ideas and thus enables progress (Malthus, 1798, p.126). This little-known element of Malthusian theory, which in fact involved the power of human capital, should be taken into account when evaluating the Malthusian theoretical framework. According to Malthus, human progress was only possible through moral restraint (a preventive check), self-reliance and continuous advancement of one's mind. These factors were to enable societies to extend their "middle parts" and counterbalance the vices and weaknesses of human nature.

While the contributions of Malthusian theory to the debate on population and environment and, more broadly, population and development, are without precedent, certain lacunae in the overall framework are worth pointing out. In addition to the previously highlighted issues, the omission of urbanisation from the overall theory stands out. It should be acknowledged that Malthus (Malthus, 1798, p.38) did mention "great cities" and "unwholesome manufactures" amongst positive checks, as during his times mortality rates in cities were particularly high. Difficult working conditions in rapidly industrialising England provided new challenges to public health and safety. Yet, throughout Malthus' *Essays on Population* the references to the impact of urbanisation on the means of subsistence are scarce. This omission is even more surprising when one examines literature analysing the urban history of England. Both 17th and 18th century England experienced an unprecedented urban growth, with new cities being formed and proportion of urban population increasing over time. While in 1670, this proportion amounted to 13.5 per cent, it grew to 17 per cent in 1700 and 27.5 per cent in 1801 (Wrigley, 1985). Initially London had the greatest proportion of urban residents; however, this situation changed in the second half of the 18th century, when other cities, such as Bristol, York, and Exeter, expanded rapidly. These urbanisation patterns had important consequences on agricultural demand and supply, but were largely excluded in the Malthusian analysis. This discussion will be the focus of Chapter 3, which will highlight in more detail the missing urban dimensions in the context of the Malthusian framework.

2.2.2 The need for a new framework

Today, we live in a different world. While in some settings population growth is likely to have influence on the availability of and access to vital resources, there are also many examples that contradict this hypothesis. At the same time, the provision of vital resources, such as healthy food and safe drinking water, remains a fundamental requirement for human development and one's exercise of substantive human rights (Sepúlveda et al., 2004). In a world where millions of people suffer from hunger and food-related diseases and where large proportions of populations do not have access to drinking water, the issue of survival remains a *sine qua non* condition for any further societal progress. At the same time, rapid urbanisation coupled with advancements in human capital and broadly understood population dynamics, including growing fertility convergence, play a key role affecting households' livelihood outcomes. In particular, unprecedented urban growth has had significant consequences on households' livelihoods, both in the developing and developed countries, albeit in different ways. A permanent expansion of human capital resulting in more complex technological applications together with globalisation processes affect the production and distribution of food. In parallel, recent fertility trends have shown exceptional declines in both developing and developed countries despite varying trends in desired vs. actual family sizes. A number of industrialised nations, such as Poland and Germany, are already at the verge of experiencing negative population growth and face long-term changes in the composition of their populations.

In this context, the main tenet of this thesis is that urbanisation, including both processes and outcomes attributable to urbanisation, constitutes a major contemporary factor affecting sustainable availability of and access to vital resources. Developing countries across the globe including emerging economies experience high urbanisation and industrialisation rates. By mid-2009, the number of people living in urban areas exceeded those living in rural regions, and this trend is projected to continue. Feeding cities has become a key challenge for the 21st century. Another challenge lies in ensuring a reduction in inequalities, not only pertaining to urban-rural differentials, but also growing intra-urban inequalities.

In the 20th century, the urbanisation process accelerated rapidly and emerged as a major phenomenon having significant impact on food security. Yet, the followers of Malthus have continued to formulate arguments in terms of "population-food-environment trap" and stressed that the primary condition for responding to food demand lies in population control (Meadows et al., 2005; Sachs, 2008a, 2009). In the 20th century, all regions, regardless of their level of development or geographical location, experienced a change in the distribution of their populations marked by an increase in the proportion of urban dwellers (Figure 2.2). While globally the current percentage of urban population is reported to be about 53 per cent, it is projected to increase to 67.2 by 2050 (UN, 2012). The number

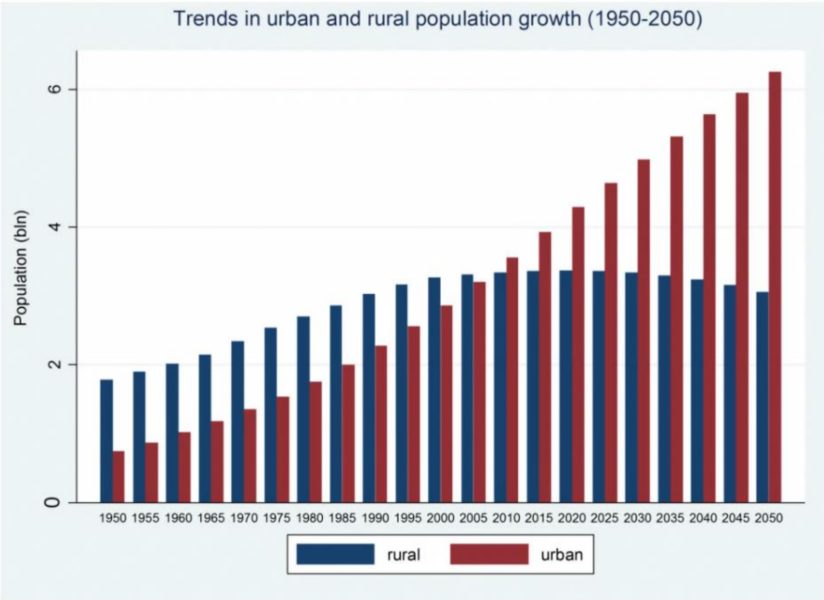

Figure 2.2 Trends in urban and rural population growth (1950-2050).

Notes: Data beyond 2010 is projected. Data source: UN World Urbanisation prospects 2011.

of megacities, with population of at least 10 million, is growing rapidly. Whereas in 1970 the world counted only two megacities, Tokyo and New York, today there are globally 23 megacities. By 2025, it is expected that there will be 37 megacities. Urban growth is faster in the developing regions and new megacities are rising mainly in Asia, which already hosts more than half of current megacities. This rapidly progressing urbanisation poses particular challenges to developing countries, which will have to continue to adapt their food production systems in order to respond to the consequences of urbanisation.

In addition to the evolving patterns in human settlements, other key contemporary dynamics are advancements in human capital and globalisation, including drastic changes in communication systems. Today, with the fast-growing internet penetration rates, the aggregate number of internet users has exceeded 2 billion (ITU, 2010). This means that currently almost one in three persons is using the internet. The network perspective argues that individuals' agency is influenced by interactions with others – the networks. The literature in this area is now in its nascent stage and it is only recently that researchers have started to investigate the impact of the internet and online social networks on union formation and fertility patterns. It has, however, been acknowledged that social networks and interactions have significant impact on fertility and couples' decisions on future family size (Keim et al., 2009). Emerging research on the role of social media in disseminating contraceptive knowledge in Taiwan (Cheng, 2011) showed that an association exists between both phenomena. It was further proved that contraceptive knowledge gained through social and mass media translated into reduced fertility. Internet and social media have considerable impact on numerous spheres of human life and this influence is likely to grow.

Moreover, movement of people represented by migration and movement of goods measured by the volume of international trade constitute key aspects of globalisation. The volume of international trade, including e-trade, is growing rapidly. The level of migration of both skilled professionals and labourers is high in all world regions. In the EU and Switzerland, since the restrictive labour laws were abolished, citizens and eligible residents have benefited from the free movement of labour and capital. International companies continue to compete for the global talent regardless of borders. The impact of globalisation on access to food will be discussed in more detail in section 3.4 in the context of the debate on the urbanisation-food security nexus. It is, however, important to stress that in this highly interconnected world a new demographic pattern is emerging. As projected by the United Nations (2010), the discrepancy amongst Total Fertility Rates (TFRs) on different continents is projected to further decrease. Based on the UN Population Division's statistics, 19 countries now experience between -0.5 per cent and 0 per cent rates of population growth. Most of these countries are geographically located in Eastern Europe, Western Europe and Japan. Many more states across the globe have total fertility rates below the replacement level.

Despite this shift in reproductive patterns arguably resulting from Malthusian positive checks[3], a considerable number of countries suffer from serious resource depletion and contamination of natural habitat. For example, in Moldova a thorough analysis of environmental issues has revealed that the country faces such problems as soil degradation and water pollution from agrochemicals, as well as the eutrophication of local water reservoirs (Sutton et al., 2007). In addition, droughts occurring every several years, in particular in Southern Moldova, cause significant losses to the country's agriculture. Ukraine, although traditionally known for its large agricultural sector, fertile soils and vast forests, has also been suffering from resource depletion. As in the case of Moldova, this is mostly caused by poor management and lack of adequate policies.

At the same time, whilst the passion between the sexes is unlikely to diminish, it is reasonable to assume that globally the operation of *contemporary preventive checks*[4] will continue to grow, thus bringing down fertility. Similarly, when it comes to the management of natural resources, technical cooperation, information exchange and migration are influencing peoples' behaviours, technological advances and policy design. As this thesis is being written, new cooperation agreements are being signed. For example, Japan and Qatar have recently agreed on strengthening their bilateral cooperation, including water and wastewater management, desalination and irrigation technologies for agriculture. Similarly, as citizens of developing countries continue to be increasingly engaged as members of the global community, including through migration and social

[3] While the positive checks operate at the fertility level, it should be stressed that from the Malthusian perspective contemporary contraception would likely be classified as a vice.

[4] It is conceptualised that the contemporary preventive checks encompass the effects of urbanisation. They will be discussed in more detail in section 2.3.3.

media, it is sensible to imagine improvement in the management of natural resources in these nations.

In this new highly urbanised, innovative, and interconnected world, the Malthusian theory should not be abandoned, but revised in order to reflect additional factors affecting resource availability and resulting health outcomes. While the primary focus of this thesis is on urbanisation, it is acknowledged that factors other than those listed above (e.g. changing nature of inequalities) have an important role in the overall framework. These factors will be included in the initial post-Malthusian framework suggested in Chapter 3, as well as in the final framework proposed in Chapter 6. In order to stimulate the development of a new conceptual feedback loop, the analysis draws from a number of theoretical and literary sources discussed in the next section.

2.2.3 Key background literature

The primary inspiration for this thesis has been the original Malthusian theoretical framework as presented in the six editions of the *Essay on the Principle of Population*, and summarised in section 2.2.1. Given the vast literature in the area of post-Malthusian studies currently falling under population and development, the arguments in this thesis draw on the existing research in this field. Taking into account the cross-disciplinary aspect of the topic, relevant complementary sources have also been considered. These comprise primarily literature from the area of international development and urban studies, including the theories of urbanisation.

<u>The neo-Malthusian debate</u>[5]

Until the present age, the Malthusian arguments have continued to stir a lively debate. On one hand, the neo-Malthusians, including Paul Ehrlich, Donella Meadows, Thomas Homer-Dixon, Norman Myers, Lester Brown and Jeffrey Sachs have been sustaining claims that population growth causes famine and environmental degradation. On the other hand, more optimistic Cornucopians, such as Julian Simon and Esther Boserup, have argued that the power of human capital and technology outweigh the consequences of

[5] This section focuses on the literature pertaining to population and resources. It should be acknowledged that a parallel body of literature exists on the relations between population growth and economic development (e.g. Coale & Hoover, 1958; Ahlburg, 2002; Birdsall et al., 2003).

population growth. One of the most renowned pessimists of the last century, Paul Ehrlich, warned that overpopulation would bring about mass starvation and societal upheavals by the end of the 20th century. In order to avoid a crisis caused by population growth, Ehrlich (1972) advocated population control, which was to be made compulsory, had voluntary methods been insufficient. While the threat of calamity resulting from population growth was particularly manifest in the developing countries, the developed world was not safe either. According to Ehrlich (1972), citizens of developed countries had a reason for concern not so much in relation to food scarcity but rather environmental degradation which was amongst the consequences of population growth. Importantly, a greater number of people implied an end of affluence in rich nations, which was likely to result in increased societal inequalities.

In their recent article reviewing claims in *Population Bomb*, Paul and Anne Ehrlich (2009) sustained their line of argument stressing that the threats resulting from growing population have never been more real. While the authors recognised a number of flaws in the original edition of the book, they maintained that the only means of reducing the pressure on the Earth's resources was through broadly understood Malthusian preventive and positive checks (Ehrlich & Ehrlich, 2009). At the same time, although Ehrlich and Ehrlich (2009) stressed that their interest was in all the factors which have an impact on the human trajectory, they failed to incorporate those in the analysis. In particular, the discussion regarding the implications of urbanisation has been limited to mentioning the interaction between urbanisation and declining fertility rates in developing countries. However, urban processes have a much wider influence on agriculture, food supply and water availability, which in turn affect people's most basic livelihood outcomes. Interestingly, the Ehrlich couple have now recognised that humanity could avoid a "collapse of global civilisation" through careful planning, multistakeholder cooperation and cultural change (Ehrlich & Ehrlich, 2013).

A similar neo-Malthusian approach has been advocated by the 1972 Club of Rome[6]. In their two flagship publications *The limits to growth* and *The limits to growth: The 30-year update*

[6] According to its official website, the Club of Rome is "an informal association of independent leading personalities from politics, business and science, men and women who are long-term thinkers interested in contributing in a systemic interdisciplinary and holistic manner to a better world" (Club of Rome, 2013). The Club of Rome was founded in 1968 and has been primarily known for its work on the population and industrial growth in relation to the Earth's carrying capacity.

(Meadows, 1972; Meadows et al., 2005), the authors claimed that the existing trends in economic and population growth were unsustainable. Contrary to the general perception, the arguments of the Club of Rome dealt with a number of phenomena outside of population growth, although related to it. In the initial edition of the book, the authors identified five primary factors impeding sustainable growth of the planet, i.e. population, industrial production, agricultural production, natural resources and pollution (Meadows, 1972). They argued that, in order to reduce the pressure on resources, both industrial growth, measured in terms of industrial output, and population increase had to be controlled and brought to an equilibrium. Regarding population growth, the authors advocated for the traditional Malthusian preventive checks, namely the reduction of the birth rate.

The urban sprawl and the consequences of urbanisation processes, more generally, received only marginal attention, primarily in the context of the availability of arable land. Yet, in the time period preceding the publication of the book, urbanisation continued to progress rapidly. Between 1950 and 1970, the proportion of urban population increased by 24 per cent globally, with the highest growth rate in the least developed countries (76 per cent). The annual rates of urban growth were also high, exceeding 5 per cent in many African, Asian and Caribbean countries (UN, 2011b). Importantly, the underlying processes of urbanisation had implications on the main growth-impeding factors considered by the *Club of Rome*, such as industrial output and pollution. In their revised 2005 version of the book, the authors presented a similar line of argument while claiming that at that stage the world had already reached a state of "overshot". In addition to the previously identified solutions, the book advocated for a change in personal attitudes and, importantly, greater equalities at the global level (Meadows et al., 2005). At the same time, however, in the updated World3 model[7] proposed by Meadows et al. (2005), the role of urbanisation remained limited to the consumer of agricultural land. The importance of these omissions was salient in a context where almost half of the world was already urban (UN, 2011b).

[7] Based on a number of underlying scenarios, the World3 simulator uses the DYNAMO programming language to project the state of the world's non-renewable resources. It can be accessed at http://www.world3simulator.org/ (last accessed on 22/12/2013).

The neo-Malthusian thinking intensified during the UN Population and Development Conference (ICPD), which took place in 1994 in Cairo. This happened after several decades of intensified efforts to scale up family planning initiatives (Padmadas, 2008). UNFPA was the lead agency coordinating the conference and follow-up actions, while the participants included international organisations, governments, and NGOs. The resulting programme of action highlighted a number of key goals, which comprised access to reproductive health services and family planning, gender equality and universal education (Demeny, 2003). The outcome of the conference was not without criticisms. John Cleland argued that the 1994 International Conference on Population and Development undermined the initial mandate of the United Nations Population Fund (UNFPA) mandate by turning its focus from macro-level population growth (UNFPA, 2005). In addition, he claimed that there was a disproportionate stress on women's rights, which led to the "feminization of population and development issues" (Cleland, 1996). Despite these arguments, the undeniable success of the conference lay in integrating the issues of population, poverty and reproductive rights under a broader agenda. Importantly, the ICPD report recognised that rapid urbanisation posed challenges to sustainable development. It was highlighted that in many developing nations the pace of urbanisation was likely to exceed these countries' capacity to deliver the necessary services to growing urban populations (UN, 1995). It was also stressed that governments should take action in order to reduce or prevent urban bias existing in the developing world.

Around the time of the ICPD and re-emerging debate about population and development, two prominent neo-Malthusians, Thomas Homer-Dixon and Norman Myers, published influential work on the threats posed by growing populations. Myers argued that behind environmental degradation resulting in displacements of populations was unprecedented population growth, in particular in poor countries. At the same time, however, he acknowledged that other factors, such as poverty, landlessness, or rapid urbanisation contributed to peoples' environmental migration. Myers and Kent (1995) claimed that due to poverty and population pressure the number of environmental refugees would continue to grow. The authors argued that international agencies should recognise the status of environmental refugees and tackle the root causes of the problem through sustainable development and targeted foreign aid (Myers & Kent, 1995; Myers, 1997, 2002).

Similarly, Homer-Dixon (1994b;a) postulated that population growth was amongst the key factors causing environmental scarcity and depletion of resources. This scarcity would have far reaching consequences, including violent conflict, resource capture or environmental marginalisation. Population growth, as Homer-Dixon claimed, was not only affecting the quantity of available resources, but also their quality. This in turn resulted in an unequal access to agricultural land or water. In many cases, elites in charge of policymaking and legislation influenced access to vital resources to their advantage, as was the case in Mauritania and the West Bank. Crucially, the ingenuity gap, which existed in many resource-poor countries, was likely to lead to social discontent and eventually conflict. At the same time, research by Gizewski and Homer-Dixon (1995) concluded that urban growth was an important factor influencing violence. While the authors stressed that the links between the two phenomena were complex, they claimed that, coupled with economic recession and increased pressure on the state to deliver services, urban growth was a key interactive factor contributing to conflict and violence.

Although a comprehensive discussion of the neo-Malthusian literature would require a thesis on its own, at the minimum the work of Lester Brown and Jeffrey Sachs should be highlighted. Similarly to Norman Myers, Lester Brown (2011) warned that the world is currently in an overshot mode. In his series *Plan B*, Brown advocated for rapid wartime-like action which would enable saving the civilisation (Brown & Brown, 2008; Brown et al., 2009). According to the author, population growth, greater overall affluence and using grains to produce fuel were the main causes of strain on the environment, and consequently environmental degradation. Population growth, in particular in developing countries including failing states, did not result in demographic dividend, but rather demographic fatigue of the governments, and eventually a "demographic trap" (Brown, 2011). Land acquisitions by richer countries, such as the Gulf states, further contributed to depleting not only farms but also water resources in the poorest nations[8]. Having recognised that "cities require a concentration of food, water, energy, and materials that nature cannot provide" (2009, p. 245), Brown's discussion of urbanisation and cities has been driven by the concern about population growth.

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[8] The issue of land grabbing will be further discussed in Chapter 3 in the context of the urbanisation-food security nexus.

Likewise, Sachs (2009) argued that through continuous population growth and increasing food production "we are eating ourselves out of house and home". Sachs advocated for robust family planning in order to reduce fertility rates and consequently stabilise the projected population size below 8 billion. In this context, he supported measures promoting voluntary contraception and legalisation of abortion. In one of his talks, Sachs (2001, 2008b) highlighted that, because of comparatively lower urban fertility rates, urbanisation constitutes an opportunity. On the other hand, higher rural fertility rates can be attributed to less demanding child-raising costs and children's contribution to farm work (Sachs, 2001). In this context, Sachs argued that weak food production systems hinder demographic transition by decelerating rural-urban migration. He stressed that, in order to ensure sustainable urbanisation, comprehensive city planning and cross-disciplinary coordination were key.

<u>The opponents of Malthus and human capital</u>

While the voices of contemporary neo-Malthusians remain strong, in particular in the context of continuing population growth, food shortages and environmental degradation, it is important to also highlight the arguments of anti-Malthusians. The proponents of the Cornucopian theory, such as Julian Simon, claimed that population pressure triggers innovation and technological advances, which act against potential resource shortages. The Simonian approach hypothesises that resources are created rather than simply used or transformed. In the same vein, Ester Boserup (1993) postulated that population size determines agricultural methods. Using Mauritius as a case study, Boserup illustrated how the country adapted to changing population dynamics by developing its infrastructure, enhancing farming techniques and ultimately increasing the agricultural output. A more detailed analysis of the arguments by Simon and Boserup will be provided in Chapter 4, which focuses on the power of human capital in the context of water access.

Importantly, referring to the Darwinian law of self-selection, acclaimed sociologist Emile Durkheim postulated that population growth leads to a greater division of labour, which in turn results in increased productivity. In his seminal publication *De la division du travail social* Durkheim (1893) argued against Darwin, stating that it was natural for people to differ and specialise in diverse segments of the market, yet coexist peacefully. If market saturation existed, people would always find a new niche to explore. He claimed that it was at the essence of human nature that people strived to always achieve more and better, which leads to research and innovation. At the same time, Durkheim (1893) argued that greater labour specialisation can result in increasing the overall economic output. It follows from this logic that in scarce conditions people are prompted to invent, thus contributing to civilisational progress.

The present study also follows on Becker's conviction that education and training are the most important part of human capital (Becker, 2004). Even though the current economic climate is different compared to the time when Becker published his key work, and certainly different to the Malthusian era, the association between education, professional occupation and earnings has always been recognised. A crucial aspect of human capital is the fact that on average it translates not only into greater income but, more importantly, it leads to innovation (Simon, 1981). In this context, women's emancipation has had an important role, not only because it allowed an increase in households' incomes and translated into women's financial independence, but also because it contributed to an overall augmentation of human capital. The concept of human capital and recent trends in human capital development will be discussed in greater detail in Chapter 4 (sections 4.3.1 and 4.3.2).

Urban theories and contemporary urban debate

Importantly, as the central argument of this thesis regards the (differentiated) impact of urbanisation on vital resources, this work borrows heavily from urban theories and contemporary literature on urbanisation and development. Inasmuch as human capital contributed to the invention of modern agricultural techniques, urbanisation has traditionally been associated with unprecedented opportunities for income generation, professional advancement and greater quality of life. It was in this context that key theories of urbanisation became prominent, including the modernisation theory and the urban bias theory (UBT). As far as modernisation theory is concerned, according to classical economics, rural urban migration and urban growth have a positive long-term impact on the economic growth of a country as well as its general modernisation (Bradshaw, 1987). While this process is likely to operate in the long run, in the short- to medium-term in the less developed countries substantial internal migration to urban areas can lead to reduced food production and greater difficulties in accessing food. At the same time, urban malnutrition is becoming a major concern, with 72 per cent of urban dwellers in sub-Saharan Africa residing in informal settlements, often at risk of poor sanitation, ill health and low income (Kimani-Murage et al., 2011). Given these developments, modernisation theory has been criticised for failing to account for negative consequences of rapid urban growth in the developing world, such as slum poverty, urban health threats, pollution and risks related to road safety.

Similarly to modernisation theory, the UBT argues that, due to the pressure by urban-based groups, states implement policies that benefit urban centres. This in turn creates disparities between cities and countryside (Lipton, 1977). Lipton (1977) argued that urban bias involved a disproportionately large allocation of resources to people and organisations in urban centres. In this context, one of Lipton's key arguments was that urban bias exists because of an urban coalition, or elite, which influences anti-agricultural policies (Pugh, 1996). Following his observations from field work carried out in rural India, Lipton argued that farmers were unable to benefit from rural-urban linkages because of policy discrimination (Jones & Corbridge, 2010). In subsequent years, critics claimed that Lipton failed to account for the differentiated nature of both urban and rural areas and the fact that societies also comprised rural rich and urban poor (Corbridge, 1989). Today, while urban bias continues to exist, the nature and scope of urbanisation have been changing, including a rise in intra-urban inequalities. It is therefore crucial to recognise that threats to peoples' livelihoods are to a large degree a result of rapid urbanisation.

While the literature on contemporary urban phenomena is becoming increasingly rich, at the very minimum the work of David Satterthwaite and Mark Montgomery should be mentioned. In particular, this thesis draws from Satterthwaite's extensive body of work on urbanisation and urban poverty in developing countries (Satterthwaite, 2002, 2003, 2006, 2009; Mitlin & Satterthwaite, 2013; Satterthwaite & Mitlin, 2013). Disentangling the multifaceted nature of urbanisation, Satterthwaite (2002) offered convincing argumentation regarding the main myths about urbanisation and why they did not reflect reality. Thus, for example, discussing myth 5, "More than half the world's population live in cities", Satterthwaite (2002, p.15) highlighted that, while the proportion of populations in urban areas has been growing, the majority of urban dwellers reside in urban centres rather than cities. Importantly, demystifying another general perception, i.e. that the speed of urban change in poorer countries is without precedent, Satterthwaite stressed the importance and relevance of historical urbanisation, including in the United Kingdom and Japan, which had both experienced a very rapid pace of urbanisation. A key body of work by

Satterthwaite and Mitlin concerns urban poverty in developing countries. Most recently, the authors provided a comprehensive set of recommendations for policy and action that can be applied at individual, local, national and international levels and which are meant to contribute to poverty reduction in urban areas (Satterthwaite & Mitlin, 2013). Crucially, they highlighted the need to return to universal targets for provision of basic necessities such as food, water, sanitation and access to healthcare. This issue will be further discussed in the context of policy recommendations, which are incorporated both in the individual empirical chapters (Chapters 3-5) and in the conclusions chapter (Chapter 6).

Similarly, Mark Montgomery (2008) argued that, given the increasing diversity of urban areas, research needed to focus on intra-urban differentials; and that traditionally research had overemphasised the significance of cities as compared to other urban locations. Importantly, Montgomery (2004) underlined the two-directional association between urban and rural areas. As highlighted by the author, despite the prevalent perception that the countryside is largely dependent on urbanities because of the income-generation opportunities, residents of urban areas often rely on the benefits attributable to the countryside. Thus, for example, rural areas are key not only to agricultural production, but also in terms of providing social and family support, such as in the case of childcare. In addition, the interests of rural and urban localities are often intertwined. For example, larger urban poverty involves fewer opportunities for potential rural migrants and lower levels of remittances (Montgomery, 2004). These rural-urban interdependencies are of particular importance in the context of analysing evolving food insecurity threats, which will be the focus of Chapter 3. In a comprehensive overview of urban health risks, Montgomery (2009) and Montgomery and Ezah (2005b) highlighted that urban dwellers are more likely to suffer from a number of diseases, including those related to obesity and mental health. Crucially, those residing in urban areas benefit from greater levels of education which, combined with opportunities for social interaction, is likely to have positive effects in terms of generation of knowledge and innovation (Montgomery, 2004).

<u>Borrowing from broader international development literature</u>

Finally, this thesis draws from the broader field of international development. Recognising the importance of the human rights framework on developmental challenges, when relevant, the thesis highlights the underpinning principles of human rights perspectives on individuals' access o food and safe drinking water. In addition, given the influence exerted by the work of Amartya Sen on developmental studies (in particular the capabilities approach), the present study borrows from the key concepts developed by Sen, such as capabilities and functionings. Bearing in mind the practical implications of this thesis, the study makes use of policy reports produced by international organisations, think tanks and NGOs. In particular, the reports by FAO and the UN Urbanisation Prospects as well as recent reports proposing priority areas for the post-MDG agenda have been inspirational.

More specifically, at the time of writing this thesis two key reports suggesting future developmental goals were published: "An Action Agenda for Sustainable Development" by the United Nations Sustainable Development Solutions Network (SDSN) and "A New Global Partnership: Eradicate Poverty and Transform Economies through Sustainable Development," by the High-level Panel on Post-MDG Developmental Agenda. When compared, the two publications may remind the reader of the traditional Malthusian debate which re-emerged during the ICPD. Thus, the recommendations of the first report follow the more traditional Malthusian approach by postulating that sustainable development is only possible within planetary boundaries[9] and that fertility reduction is a necessary condition for achieving progress in development. Rapid population growth is listed amongst the key factors contributing to the vicious circle of poverty and hunger. As a concrete objective, the report suggests continuing voluntary fertility reduction programmes in all countries where TFR is above replacement level (SDSN, 2013, pp.28-29).

On the other hand, the report by the High-level Panel on Post-MDG Developmental Agenda (therefore "the Panel") offers a more innovative and forward-looking approach. It focuses on five necessary shifts, i.e. development for all, sustainability, jobs and inclusive growth, open and accountable institutions, and global partnerships. These suggested shifts are complemented by a "vision to action" approach and a strong emphasis on data quality. As part of its holistic approach, the Panel highlighted the need for universal access to sexual and reproductive rights stressing that 222 million of women globally were still unable to prevent unwanted pregnancy (United Nations, 2013a). Other issues such as environment, healthy nutrition, fair trade system, employment and enhanced framework for business opportunities are also at the core of the overall strategy. Importantly, as in the previous report, the emphasis on urbanisation and cities as both motors for modernisation

[9] At the same time no measurement of planetary boundaries has been provided.

and contributors to environmental challenges has been highlighted. Moreover, both reports stress the need to focus on the most vulnerable regions and the least developed countries, which is in line with the argumentation of this thesis (both Chapter 4 and Chapter 5 concern LDCs).

Before proceeding with empirical analyses, the next sections provide background on key issues pertaining to urbanisation, i.e. historical context, geneses of urbanisation, conceptual foundations and measurement challenges.

2.3 The urban context

2.3.1 Urbanisation in the age of Malthus

In order to understand both the background behind the Malthusian theory and the motivation for this thesis, it is important to provide the relevant historical perspective. The historical context of interest refers in particular to demographic and urban developments occurring in the Malthusian era. During Malthus' lifetime, overall population in England and Wales grew considerably; from around 6.5 million in 1760 to almost 14 million in 1830, according to the records from the 1831 census. At the same time, in 18th century England, poverty dominated the lower strata of the society and the increase in food prices made it difficult for the poor to afford food. The Poor Laws were introduced and parishes collected taxes in order to help the disadvantaged strata of the society meet basic survival requirements. Growing towns had to become home for many new residents, including those with little income, and thus swarmed with homeless families, the sick, and individuals with disabilities. In addition, at the same time, other countries across the globe witnessed hunger and famines. India suffered from the Bengal famine (1770), Chalisa famine (1983-84), and Doji bara famine (1789-92), and China followed with famines in 1810 and 1811. Throughout Europe, countries such as Germany, Sweden, Iceland and the Czech Republic all witnessed famines in the 18th century. Tunisia and Egypt both suffered from widespread famines towards the end of the 18th century. This situation provided Malthus with excellent arguments to support his claim in the repeatedly revised editions of the *Essay on the Principle of Population*. In his analysis concerning the potential impact of population growth on means of subsistence, Malthus so fiercely defended his argument about the causal effect of population size on food that he neglected the power of industrialisation and urbanisation on the availability of and access to key natural resources. Although historians dispute the exact dates of the industrial revolution, it is broadly agreed that it involved a process of economic change from agriculture to manufacture, which took place between 1760 and 1840. Occupational structure of the population reported by Lindert and Williamson provides further insights. While in 1759, 24.6 per cent of families in England and Wales worked in agriculture, in 1801-03 the proportion of families employed in agriculture had dropped to 14.6 (Mitchell, 1988). The changing trends in terms of agricultural workers vs. labourers were likely to be the result of evolving property rights and land enclosures. In the 19th century, the proportion of families working in agriculture continued to decrease. Based on the census information, which distinguishes between three occupational categories (1. agriculture, 2. trade, commerce and handicraft; and 3. others) agricultural employment in Great Britain declined from 35 to 28 per cent between 1811 and 1831 (Mitchell, 1988). Alongside the increasing process of industrialisation and urbanisation of the country in the same period, this decline continued throughout the 19th century. Similar trends can be observed when looking at the composition of National Accounts in the 19th century (Figure 2.3). While factor cost from agriculture remained at

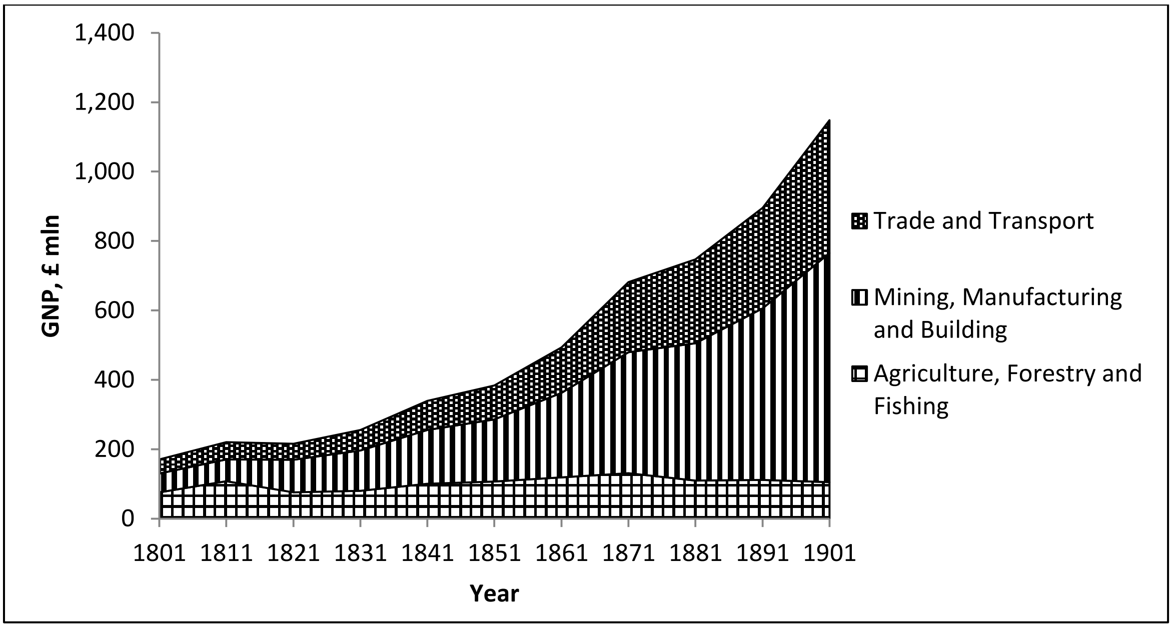

Figure 2.3 GNP at Factor Cost – Great Britain 1801-1901 (in £ million).

Data source: Mitchell, 1988.

similar levels throughout the century, the income from trade and transport as well as mining, manufacturing and building, continued to grow. These evolving trends in occupational patterns and income distribution accompanied an increasingly important urbanisation process.

While the phenomenon of rapid urbanisation is not new, the terminology (ies) describing the process became popular only in the 20th century. When screening through historical statistics, the word "industrial" appears frequently, whereas it is impossible to find any mention of "urban", let alone "urbanisation" (Mitchell & Deane, 1962; Mitchell et al., 1971; Mitchell, 1988). Clyde Mitchell (1969) states that the word urbanise was first used in 1884 (well after the death of Malthus) and referred to becoming a city. However, it remains a historical fact that during Malthus' times England, and to a lesser extent continental Europe, witnessed significant growth in industry, which cumulated in what was to become the industrial revolution. The development of industry triggered the need for cheap labour and hence produced huge migration flows into the cities. Migration into cities was the primary cause of urban growth in England in the late 18th century (Williamson, 1988). When compared with other European countries, there is evidence that the British population was much more mobile. This could partly be explained by the fact that the benefits received under the Poor Laws could be claimed in geographical locations other than one's native place (Wrigley, 2004). It is therefore surprising why, in the context of his theory on population growth and food, Malthus made very limited references to urbanisation and population distribution. It was during the Malthusian era that in England the share of urban population increased tremendously: from 25.9 per cent in 1776 to 65.2 per cent in 1871 (Williamson, 1988).

In addition, regional data from South England confirm shifting patterns in the occupational structure of the population, which was one of the characteristics of increasing urbanisation in 19th century England. Figure 2.4 shows data points for the four geographical areas with which Malthus was particularly familiar - Surrey, Cambridgeshire, London and Herefordshire. As can be observed from the chart, percentages of families working in trade, handicraft and manufactures are above 25 per cent for all the four regions. London, not surprisingly, counts 54 per cent of such families, followed by Surrey with 35 per cent. The growing demand for food resulting from rapid urbanisation accompanied by poor harvests and the war with France led to price hikes in food products, which in turn resulted in greater poverty (Turner, 1986). At the same time, the rich landed classes were able to make a profit and contribute to the country's agricultural and industrial production (Cannadine, 1986). This evolving reality provided Malthus with inspiration in establishing his theoretical foundations and highlighting the issues of social stratification and micro-level inequalities.

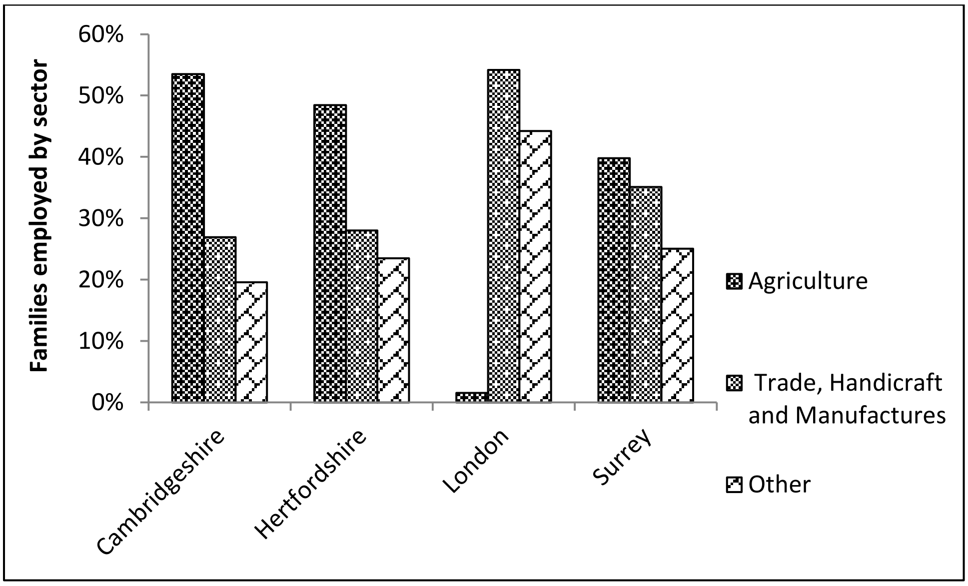

Figure 2.4 Percentage of families working in agriculture, trade, handicraft and manufactures, and other occupations in four English regions (1831 census).

Data source: Population census 1831.

2.3.2 Geneses of urbanisation

The geneses of urbanisation are not uniform and differ depending on the regional, developmental or country-specific circumstances. Urban origins are also closely linked to other historical factors, such as geographical environment, trade and colonial expansion. While cities existed in the pre-industrial era, it was only in the 20th century that urbanisation became a globally widespread phenomenon. In Europe, the fastest pace of urbanisation occurred in the second half of the 19th century and at the beginning of the 20th century. In 1914, the developed world counted 281 cities of over 100,000 inhabitants, while by 1980 this number had grown to 1,006 (Bairoch & Goertz, 1986).

More specifically, when analysing the geneses of urbanisation several factors need highlighting as having contributed to urban growth in Europe. The above-mentioned study by Bairoch and Goertz (1986) stresses the role of commercial activities which resulted in transformation of landscape and centres of power. Not surprisingly, countries which were most active in geographical explorations, such as the UK, the Netherlands, Portugal or Italy, developed trade links which prompted the growth and importance of cities in their settlement systems. At the same time other nations, particularly in Scandinavia, or Russia, remained relatively little urbanised. This can be explained by the fact that the Neolithic revolution in these countries occurred comparatively late. The Neolithic revolution not only changed the process of agricultural production but also contributed to establishing more sedentary societies. In addition to this dimension, it is argued that some Northern countries experienced relatively late urbanisation because of the cold climate, which entailed a need for combustibles and a lower agricultural production (Bairoch & Goertz, 1986). Figure 2.5 provides an overview of urbanisation process in the early and later industrialised countries (as defined in the note to Figure 2.5).

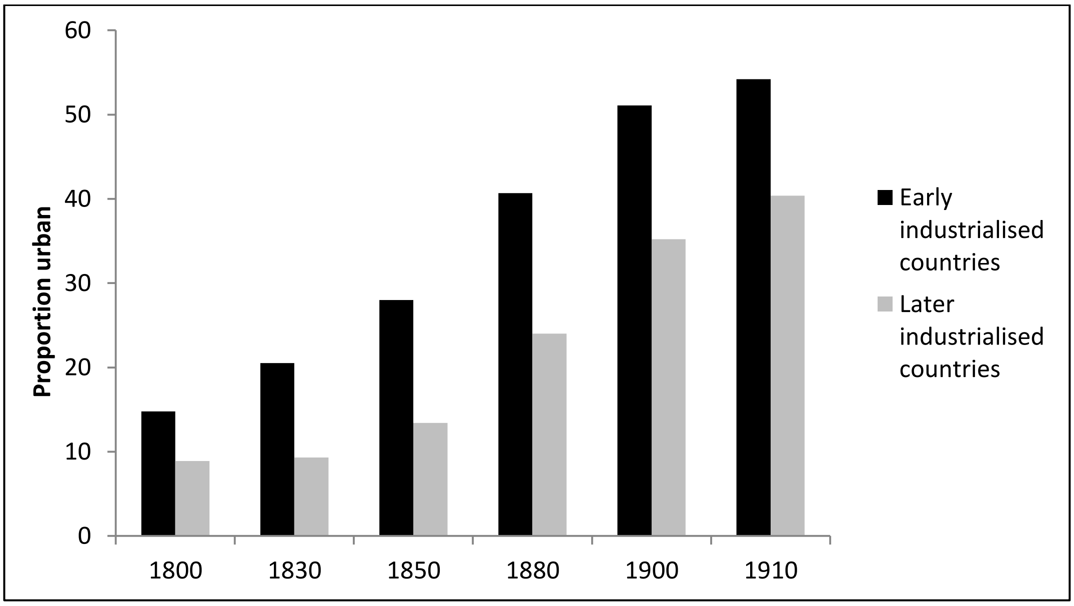

Figure 2.5 Proportion of urban population in early industrialised and later industrialised European countries (1800-1910).

Notes: Early industrialised nations include Belgium, France, Switzerland, and the United Kingdom, while later industrialised countries are Austria-Hungary, Germany and the Netherlands. Data source: Bairoch and Goertz (1986).

Another factor contributing to European urbanisation involved changing property rights related to land. In England, the enclosure movement had already started in the 16^{th} century (World Bank, 2009) and gradually intensified. The enclosure process was dictated by the agricultural progress and related profitability of the land. During this time, many peasants were dispossessed of their land and made to work for feudal estates (Ciriacywantrup & Bishop, 1975). This in turn caused peasant displacement resulting in greater migration to cities. Already in 1800 England had achieved a level of urbanisation which was not attained by any other country until half a century later (Kingsley, 1955). In England, and subsequently in other European countries, urban expansion progressed quickly, following the process of industrialisation and the emergence of industrial capitalism. In this context, the interdependency theory provides geographers with a useful tool to argue that urbanisation can be explained as a spatial product of capitalism (Clark, 1998). Industrialisation, which created the factory system of manufacturing, entailed unprecedented labour migration to the cities and caused further urban growth. Thus, for example, Engels argued that Manchester's thriving growth was to be explained by "manufacturing under capitalism" (Kelley & Williamson, 1984, p.419).

Analysing societal and demographic changes in industrialising England, researchers have been concerned with explaining the causes of modern population growth. While McKeown's hypothesis states that the decrease in mortality in 19^{th} century England should primarily be attributed to raising living standards, including nutrition (McKeown, 1976; Colgrove, 2002; Harris, 2004), McKeown's critics highlight the importance and negative impact of urban processes on human survival during this period. Research has shown that during the Malthusian era urban dwellers suffered from lower life expectancy compared to their rural counterparts, and that spatial inequalities existed in terms of access to food and health services (Szreter, 1998; Szreter & Mooney, 1998). In particular, studies investigating improvements in urban mortality highlighted the important role of sanitation and personal hygiene as key contributors to population growth (Szreter & Mooney, 1998; Harris, 2004). This discussion will be further referred to in Chapter 5, which focuses on contemporary intra-urban inequalities in developing countries.

The origins of urbanisation in North America have been attributed to wide-scale migration from the European continent accompanied by a propitious property rights system and rapidly developing transportation links. For example, Dutt et al. (1994, p.383) stressed that in the 19th century America acted as a "safety valve" for Europe, absorbing European surplus population as the colonies offered extra job opportunities. Yet, immigration alone cannot be considered as the primary factor accounting for American urbanisation. More plausibly, the impact of technology, in particular transportation but also industrial energy, became a crucial pillar which enabled greater trade and contributed to the establishment of cities. Borchert (1967) argued that these technological innovations together with the resource base of the hinterland constituted key elements enabling further economic growth and geographical diversification of the United States. Thus, despite the fact that there were no urban settlements in pre-Columbian America, urbanisation of the USA progressed rapidly in the 19th and early 20th centuries (Bairoch & Goertz, 1986; Pacione, 2009). While in 1800 the urban population in the country amounted to 5.3 per cent, in 1900 the number reached 35.9 per cent (Bairoch & Goertz, 1986).

Although today the countries in the Gulf region are classified as highly developed, their developmental path has been distinct from that of the Western countries. Inasmuch, the urbanisation processes and trends in the Gulf region differed from those discussed above. This previously nomad region experienced very rapid urbanisation in the second half of the 20th century. The urbanisation process was triggered by the economic boom that followed the discovery of oil and gas and the creation of the petroleum industry in the region. This new sector created job opportunities and thus attracted foreign labour, resulting in urban population growth and increased consumption. While the urbanisation process in the Gulf has primarily been influenced by economic factors, hydraulic theory claims that, because of water scarcity in the Middle East, cities were created to enable central management of precious water resources, which were key to agricultural production (Wittfogel, 1957; Pacione, 2009). Although today desalination increases scarce water resources in the Gulf, centralised management systems together with highly developed infrastructure and concentrated settlements allow more efficient resource distribution. It is also sensible to infer that human capital accumulation which occurred in the urban centres has further contributed to relatively well-managed urban growth in this region.

In most developing countries the origins of urbanisation were yet different (although not uniform throughout the group). Dissimilarities between developed and developing countries played in terms of the overall social and economic environments in which urban processes took place. For example, the rates of natural increase have been much higher in the rapidly urbanising developing world. In addition, research points out that "natural endowments" and "higher absolute levels of development" were greater in Europe and North America at the times of their urbanisation (Kasarda & Crenshaw, 1991). Dutt et al. (1994) offer a comparative analysis of the origins of urban growth between the West and Asia. The authors point out that in Western societies urbanisation was primarily triggered by rural-urban migration, which was a result of industrialisation and division of labour. On the other hand, in Asia, natural increase was the main factor behind urban growth in the region, not only because of high urban fertility rates, but also through a "rural push" due to large populations in the countryside (Dutt et al., 1994). Another body of literature suggests that in the 20th century the rapid urbanisation of South Asia was triggered by post-colonial industrialisation processes resulting in turn from increasing globalisation (Hackenberg, 1980; McGee, 2009). Following this logic, the rural-urban migration was a consequence of an increased demand for labour triggered by the global economy.

The pattern of Chinese urbanisation has received much attention because of its unique trajectory. China experienced rapid urbanisation in the period of open door policy and economic reform (Zhu, 1999; Gu et al., 2012). The process was described as the bottom-up model, or otherwise "urbanisation from below" (Gu et al., 2012). It was characterised by the advancement of urban growth caused by exchanges of agricultural by-products and government's investment in small cities (Gu et al., 2012). In the 1980s, the Chinese government created special economic zones and opened today's largest coastal cities, which contributed to greater migration and increased levels of "floating population". Gu et al. (2012) stressed that the opening up of China's coastal cities changed the factors driving Chinese urbanisation from intrinsic to external. Economic globalisation combined with strong pull factors caused by opportunities in manufacturing became key drivers of urbanisation. In its recent report, the UN (2012, p.14) estimated that "between 2000 and 2050, urban growth will be the sole driver of the increase in the urban population of China".

On the other hand, Latin America, which continues to be classified as a developing region despite a number of upper middle income and high income economies, is today the most urbanised continent in the world. As per the most recent UN data (UN, 2011b), in 2011 almost 80 per cent of the population in Latin America and the Caribbean was living in urban areas as compared to around 41 per cent in 1950. While the most rapid urbanisation occurred in the 20th century, urban processes date back to the ancient civilisations of Mayas Incas and Aztecs which were all associated with large urban centres (Rodgers et al., 2011). In addition, the arrival of the colonial powers further contributed to the continent's urbanisation as the colonial administration was largely managed by a network of interconnected cities which were perceived as centres of power and control (Rodgers et al., 2011). Subsequently, in the 19th century and the beginning of the 20th century, the process of urbanisation continued as countries gained independence, reorganised their governance structures and emerged as key exporters to global markets (Cerrutti & Bertoncello, 2003). Lattes et al. (2004) highlighted that the process of rapid contemporary urbanisation in Latin America occurred as a consequence of two important societal transformations. First, the rapid industrialisation supported by governments' import substitution policies which contributed not only to the modernisation of Latin American countries, but also to large migration to the cities.

In some countries, like Brazil, the industrialisation process was highly unequal and led to increasing regional inequalities (Caetano, 2001; Caetano & Potter, 2004). Second, the promotion of structural adjustments and opening of economies resulting in the growth of informal sectors and increasing urban poverty (Lattes et al., 2004). The urbanisation process in Latin America was unique also because of the unprecedented pace of urbanisation – twice that of Northern America. This has inevitably resulted in many developmental challenges, including growing spatial and societal inequalities. Importantly, in terms of the key drivers of urbanisation in contemporary Latin America, population growth is the main contributor behind urbanisation while urban to rural migration and reclassification account to only 30 per cent of the total urban growth (Martine et al., 2008). Overall, rural to urban migration as a contributor to urban growth has been declining; however there exists important variation amongst specific countries. For example, between 1990 and 2000 in Brazil, urban to rural transference accounted to 34.5 per cent of the overall urban growth, while in Ecuador and Haiti it constituted more than 50 per cent over the same time period (Lattes et al., 2004).

Finally, considering the African experience, literature highlights that the seeds of urbanisation were planted in the process of expansion of coastal settlements and administrative centres, which took place in the colonial period. In her study on urbanisation in Africa, Coquery-Vidrovitch (1991) claimed that such an approach did not reflect the reality. The author pointed out that, although in some cases new settlements were indeed created, most often the existing towns or villages were used and adapted by the colonisers. As Coquery-Vidrovitch (1991, p.36) explained "The change was not so much an emergence of cities, but an alteration of the previous urban networks and hierarchies between small trading centres and new selected metropoles, most of them located along the coast, since colonisation aimed at generalizing an outward-oriented market economy". Similarly, Tettey (2005) pointed out that both urban bias theory and modernisation theory fail to explain the pre-colonial urbanisation in Africa.

There is, however, a general consensus concerning the causes of urban growth in sub-Saharan Africa in the 20th century. Scholarly literature stressed that in the first half of the 20th century, migration from rural to urban areas caused by income disparities and perceived opportunities in the cities has been the primary reason for rapid urbanisation, while more recently natural increase has become the main driver behind urban growth in the region (Beauchemin & Bocquier, 2004; Potts, 2009; Falkingham et al., 2012). Beauchemin and Bocquier (2004) reported that in Africa 75 per cent of urban growth was due to natural increase, which is significantly higher when compared to other world regions. In addition, continuous reclassification, circular migration and observed counter-urbanisation contribute to further complexities when analysing urban trends in sub-Saharan Africa. A summary of urban origins is provided in Table 2.1, while the next section offers a typology and definition of contemporary urbanisation.

Table 2.1 Summary of global urban origins.

Urban origins	
Indirect	Direct
• Industrialisation • Globalisation • Labour markets & labour demand • Expected labour demand • Colonisation • Overall population growth • Human capital & technological advancements	• Rural-urban migration • Urban population growth (natural increase) • Reclassification of areas of residence

2.3.3 Definition and typology of urbanisation

Before undertaking any analysis pertaining to urbanisation, it is important to define what "urbanisation" and "urban" mean as well as to acknowledge measurement challenges related to urbanisation. Both the concept of urbanisation and the division between urban vs. rural have often been subject to academic and policy debates. Almost half a century ago, Kingsley Davis (1965, p.41) provided a simple definition of urbanisation as "the proportion of the total population concentrated in urban settlements" or "a rise in this proportion". Following the UN guidelines, the Organisation for Economic Cooperation and Development (OECD) defines urbanisation as "1. increase in the proportion of a population living in urban areas; 2. process by which a large number of people becomes permanently concentrated in relatively small areas, forming cities" (OECD, 2012a). While the first aspect of this definition implies thinking of urbanisation as a direct result of demographic processes, the second part of the definition conceptualises urbanisation as a broader phenomenon. To complement the above definitions, a social aspect of urbanisation should also be highlighted. Thus, Bhatta (2010, p.3), for example, referred to urbanisation "a social process, which refers to the changes of behaviour and social relationships that occur in social dimensions as a result of people living in towns and cities". This definition of urbanisation is particularly interesting for both sociologists and demographers, as it implies that peoples' behaviour, norms, and resulting fertility and family formation patterns change through the process of urbanisation. Indeed, there exists vast evidence that urban fertility is in general lower as compared to rural fertility, a point often highlighted by Jeffrey Sachs (e.g. Sachs, 2001). Already in 1942, Abram Jaffe concluded that the urban-rural fertility divide existed far beyond Europe. Moreover, this fertility differential occurred already in the 19th century and possibly earlier (Ziraba et al., 2009).

This thesis proposes a revised definition of urbanisation as "a process of population concentration, which has important demographic, social and environmental ramifications".[10] By applying this modified definition, the stress is placed on both the process as well as impact of urbanisation. As highlighted in the previous section, urban origins may vary depending on regional and country-specific historical circumstances and contemporary dynamics (Davis, 1955; Coquery-Vidrovitch, 1991; Beauchemin & Bocquier,

[10] On the other hand, urban growth is defined as "the increase in the number of people who live in towns and cities" (UNFPA, 2007, p.6).

2004). These include direct demographic causes, such as rural-urban migration or natural increase in urban populations through high fertility rates, or to a lesser extent lower mortality. In addition to the demographic factors, a number of other influences exist, which were discussed in the previous section. Globally, urban areas continue to grow while the countryside is being diminished. This process has been accompanied by increasing reduction in per capita agricultural land. Importantly, urbanisation is closely linked to demographic transition (Dyson, 2011). Historically, it has been observed that the process of urbanisation does not discontinue in countries until a high level of proportion of urban population is achieved. On the other hand, once urban residence becomes predominant, as is the case in most European nations, typically de-urbanisation trends follow.

Traditionally, cities have become the core of business and politics, and thus often represent the centre of power and distribution of state welfare, if such is provided. The positive effects of urbanisation, linked to its relatively better infrastructure and amenities, can be conceptualised as contributing to *contemporary preventive checks*. As in the original Malthusian framework, these positive checks operate through the reduction of fertility associated with urban bias and higher standard of living. These effects can operate at both macro and micro level; at the country level they are closely linked to demographic transition, while at the micro level they are related to the traditional "urban advantage". In this context, the word "preventive" can be understood as having a preventive effect in terms of potential fertility hikes. At the same time, however, *contemporary preventive checks* are also closely associated with the overall positive aspects of urbanisation, such as economic modernisation, generation of income and quality of life.

At the same time, as highlighted previously, urban spaces are far from homogeneous; they comprise large cities including megacities as well as a vast net of smaller towns and their respective peripheries. Often, in the absence of clear administrative divisions, it is hard to establish where the boundaries between urban and rural exist. Importantly, when the proportion of urban dwellers grows, so does the diversification of this group and inequalities in access to basic means of subsistence. Diversification of urban areas encompasses the size and density of urban centres as well as social class and capabilities of urban dwellers. While in the developed countries urban groups tend to be more homogeneous, which is linked to the governmental provision of social welfare, in developing countries large rural-urban inequalities and increasing intra-urban inequalities persist. Spatial inequalities related to the place of residence are often complemented by inequalities resulting from households' financial situation (income-based), households' size (demographic) or both. The discussion regarding inequalities will be the focus of Chapter 5, which will examine the case of rapidly urbanising LDCs.

Finally, when discussing urbanisation it is crucial to highlight the difference between the effects of urbanisation as an ongoing process and its impact once the process of rapid urban growth has ended (i.e. "urbanisation outcomes"). Today, the consequences of urban processes are more salient in developing countries. Rapid urban growth when uncontrolled can result in large informal settlements which often lack access to basic amenities. In these circumstances, fundamental human rights, such as access to schooling for children, or access to safe drinking water are frequently compromised. In addition, due to challenges in ensuring hygiene and non-existence of public health services, slum dwellers tend to be at high risk of ill health. On the other hand, both developed and developing countries are likely to be affected by direct and indirect outcomes of urbanisation rather than the consequences of urbanisation processes. In this context, obesity constitutes an excellent example. As an outcome of urbanisation, individuals invest less in physical activity, which coupled with changing dietary patterns can have dramatic impact on human health. These negative effects of urbanisation (contributing to greater mortality rates) can be thought of as *contemporary positive checks*.

Table 2.2 provides an overview of the differentiated impact of urbanisation in the form of a typology. A distinction is made between two separate, but complementary aspects of urbanisation. These are the quality and the quantity of the urban process; where quality can be evaluated based on the impact on households' livelihoods, while quantity is measured by traditional indicators of urbanisation, such as proportion of urban population, urban growth rate and percentage of urban population living in slums. Logically, quality and quantity aspects are intertwined. Phenomena such as environmental degradation can be linked to a rapid rate of urban growth. It is important to highlight that the quantitative indicators mentioned in the typology relate to direct measures of urbanisation only. Other indirect indicators based on the quality aspects of urbanisation can be translated into quantitative measurements. These can include variables on infrastructure, education or fertility rates.

Both aspects of urbanisation, i.e. the qualitative and the quantitative, can translate into either a negative or a positive impact. Qualitative impacts encompass demographic, social and ecological phenomena, including the effect of urbanisation on fertility rates, population age structure and social ties. Here, a potential negative outcome can be the loosening of traditional kinship and family relationships. Environmental impacts can be as broad as a potential reduction of fish stock caused by rapid urbanisation (a negative outcome) and improvements in infrastructure, which facilitate the distribution of food and water (positive outcome). On the other hand, direct quantitative impact can involve a large number of slum dwellers in a country or a high rate of urban growth, in particular when this growth is poorly managed. A positive effect can be thought of as attributable to urban advantage related to urban residence. The differentiated impact of urbanisation will be further

Table 2.2 Typology of urbanisation.

<table>
<tr><th>Aspect of urbanisation</th><th colspan="2">Assessment/ measurement</th><th>Mitigating/ confounding factors</th><th>Negative impact</th><th>Positive impact</th></tr>
<tr><td rowspan="3">Quality</td><td rowspan="3">Qualitative*</td><td rowspan="3">Impact on households' livelihoods [quality of life]</td><td rowspan="3">Macro: Human development context, including country's welfare policies

Micro: socio-economic characteristics</td><td>Environmental: pollution, crowding, disease</td><td>Environmental: better infrastructure</td></tr>
<tr><td>Social: looser social ties, potential lack of care</td><td>Social: potential for human capital development</td></tr>
<tr><td>Demographic: population structure, including aging</td><td>Demographic: lower fertility</td></tr>
<tr><td rowspan="3">Quantity</td><td rowspan="3">Quantitative</td><td>Rate of urban growth & pace of urbanisation</td><td rowspan="3">Macro: Indicators of human development

Micro: socio-economic indicators</td><td>Rapid/unplanned urban growth</td><td>Slow-moderate pace of urbanisation</td></tr>
<tr><td>Urban place of residence</td><td>Poor urban households</td><td>Urban households (non-poor)</td></tr>
<tr><td>Urban population in slums</td><td>Large proportion of urban population in slums</td><td>No slums</td></tr>
<tr><td colspan="4" align="right">Contribution to:</td><td>Positive checks</td><td>Preventive checks</td></tr>
</table>

Note: * Often leads to development of additional quantitative indicators.

discussed in Chapter 3 in the context of the analysis of interlinkages between urbanisation and food insecurity. The next section focuses on key measurement issues related to urbanisation and classification of urban areas across countries.

2.3.4 National classifications of urban areas

When it comes to national classifications of "urban", the United Nations' Department of Social and Economic Affairs (DESA) acknowledges that different countries have their own definitions of urban and rural areas. While supranational efforts exist to provide a certain degree of standardisation, with the probably most well-known examples of the EU and OECD, at the national level countries tend to have their own distinct classifications. Given that it is impossible to analyse each and every country in detail, this section provides selected examples so as to highlight inter-country differences. The purpose of this discussion is to acknowledge that international comparisons are not based on a uniform set of standards, but rather on best-adapted practices often resulting from a variety of compromises. In order to ensure a broad geographical overview, this section will first focus on several highly urbanised European countries, then large emerging economies, and finally a number of African nations.

First, the cases of England and Wales and Norway are discussed as European examples. According to the Office of Nations Statistics (ONS), in England and Wales the definition of urban/rural is based on settlement approach, with settlements of 10,000 or more being classified as urban (Malik et al., 2013). Hectare grid squares are used as the minimum classification areas. These are then combined into larger geographical entities, including Output Areas (OA), Wards and Super Output Areas (SOA). Overall, at the smallest level of OA a settlement can be classified as 1) urban, 2) town and fringe, 3) village, or 4) hamlet and dispersed. Within each category, further classification is related to the criterion of sparsity. Thus, a settlement can be sparse or less sparse depending on the number of households in the relevant hectare grid squares. The details of the method are spelled out in a joint report by the Countryside Agency, the Department for Environment, Food and Rural Affairs (DEFRA), ONS and the Office of Deputy Prime Minister (Webb & Rogers, 2003).

In Norway, the country with which Malthus was particularly impressed (Malthus, 1799; Drake, 1966), urban settlements are defined as agglomerations of houses with more than 200 residents (OECD, 2007). In addition to this condition, the distance between houses in urban settlements should not exceed 50 metres. As a comparison, in other Nordic countries, such as Denmark and Sweden, the equivalent distance is set to 200 metres (OECD, 2007). Based on these criteria, as of 2011, Norway was almost 79 per cent urban as compared to around 20 per cent in 1865 (OECD, 2007; UN, 2011b). The South-Eastern part of the country is most urbanised with Oslo being the only city exceeding 500,000 inhabitants.

In the large economies, such as Brazil, Russia, India and China (BRICs), the urban-rural classifications are yet different. Thus, in China, a country which experienced rapid urbanisation, urbanisation is usually defined "as the convergence process of population to urban areas" (Liu et al., 2003, p.7), which is measured by a ratio of urban population to the total population of the country. Urban areas are officially designated by the government as well as at the provincial level. However, as Liu et al. (2003) pointed out, the criteria for designation of these areas are complex and have been changing over time. In 1955, for instance, places "with seats of county level and above state government agencies or with a clustered population of 2,000 of which 50 per cent or more are non-agricultural population" (Liu et al., 2003, p.8) could acquire the status of designated towns. The current system takes into account a number of factors, such as the size of population including non-agricultural population, income and infrastructure of an area.

Chang and Brada (2006) reported that after 2000 migrants who were urban residents for at least six months were also counted amongst the urban population. In addition, at that time the density criterion for urban areas was specified at 1,500 persons per square kilometre (Chang & Brada, 2006). Moreover, it has been observed that in practice two parallel systems of defining "urban" exist – one based on the spatial distribution and another parallel system, based on inhabitants' personal registration (Hussain, 2003). This latter system is known as 户口 or *hu kou*, using the pin ying transcript. Individuals with non-urban *hu kou*, but residing in a city, are not considered to be legitimate residents of that urban area and therefore are likely not to be counted as part of the urban population. In addition to introducing bias in the classification system, the *hu kou* issue creates far reaching challenges, including underestimation of urban poverty. Finally, because of the dynamic nature of China's urbanisation and the resulting changes in the classification of urban areas, caution is needed when referring to urban and rural categories.

On the other hand, India classifies an area to be urban if it fulfils one of the following conditions: 1) a place which hosts a municipality town area committee, corporation or cantonment board, 2) a place which has a population of at least 5,000 inhabitants, its population density amounts to at 400 persons per sq. km or more, and at least 75 per cent of that area's working male population are employed in non-agricultural sectors (Government of India, 2011). According to the Indian Government, settlements that fulfil the first condition are designated as Statutory Towns (ST), whereas places satisfying the three criteria under point 2 are classified as Census Towns (CT). In addition to these two categories, there exist urban agglomerations (UA) and out growth areas (OG), which refer to settlements such as ports, railway colonies, campuses or any other areas that have identifiable boundaries. According to the 2011 census, India counted 7,935 towns; an increase of 35 per cent since the previous census was conducted in 2001. Comparatively, in Brazil defining urban areas lies in the competency of each municipality (IBGE, 2011). Thus, at the national level "urban" refers to any urban or sub-urban area as defined by respective municipal authorities (UN DESA, 2012b).

African countries, which are amongst the least urbanised nations globally, have been experiencing unprecedented urban growth with annual growth rates as high as 6 per cent for Burkina Faso and Uganda (2005-2010). On average, between 2005 and 2010, the least developed countries, most of which are located in sub-Saharan Africa, had an annual urban growth of 3.7 per cent as compared to 2.6 per cent for other developing countries (UN, 2011b). While overall the African continent is dynamically urbanising, considerable differences exist both in terms of the rate of urban growth and in definitions of urban areas. For instance, Ghana since gaining its independence in 1957 has seen improvements in the infrastructure and information networks accompanied by a high rate of urbanisation. Ghana defines urban settlements as those with at least 5,000 inhabitants (Owusu, 2005; Obeng-Odoom, 2010). Although the proportion of urban population continues to grow, the definition of urban areas has remained constant since Ghana's independence. The percentage of urban population in Ghana has increased from 15 per cent in 1950 to 51 per cent in 2010 (UN, 2011b). Accra and Kumasi are the largest urban centres in Ghana with 34 per cent of urban dwellers residing in these cities (Obeng-Odoom, 2010).

In Ethiopia, a country, which has one of the lowest rates for urban population, cities are defined as settlements of more than 2,000 people (Schmidt & Kedir, 2009). Similarly, Liberia defines its conditions for urban areas as localities exceeding 2,000 inhabitants (UN DESA, 2012b). With these definitional differences, establishing joint standards remains a challenge for both international and regional agencies as well as cross-national survey organisations. In order to allow comparisons, the UN statistics are based on the national classifications. The full UN list of different national definitions is included as Appendix B. At the same time, Measure DHS by Macro developed its own classification of types of residence, which comprises the following four categories: capitals and large cities (with more than one million inhabitants), small cities (between 50,000 and one million inhabitants), towns (other urban areas), and countryside. Both UN and DHS classifications will be used throughout this thesis.

CHAPTER 3 URBANISATION AND FOOD INSECURITY: THE ROLE OF HUMAN DEVELOPMENT IN A POST-MALTHUSIAN FRAMEWORK

Abstract – Urban processes and trends as well as different aspects of human life in cities have recently benefited from an intensified research effort. Yet, little attention has been paid to the impact of urbanisation on food insecurity in the context of Malthusian and post-Malthusian studies. In addition, there has been little investigation regarding the evolving nature of food insecurity and how urbanisation affects food insecurity risk in different developmental settings. This study examines the above research problems by drawing evidence from post-Malthusian literature as well as policy-oriented research in the area of food security and world development. The Food Insecurity Risk Index (FIRI) has been developed and used as an outcome variable, while key explanatory variables include the rate of urban growth and indicators of human development. The results of regression modelling of aggregate international data have confirmed a significant negative impact of urban growth on food security at a national scale. Evidence suggests that countries' level of development has a mitigating effect on this association, with education showing the greatest positive influence. Finally, the results further confirmed that other macro-level phenomena, including TFR, the proportion of agricultural land and indicators of globalisation, have a significant direct effect of the food insecurity risk. The paper concludes by providing a set of recommendations for development agenda.[11]

Key words: Malthusian theory, urbanisation, food insecurity risk, human development

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[11] A previous version of this chapter has been presented at the British Society for Population Studies (BSPS) Annual Conference 2012 and the PopFest Conference 2012.

> *"The quest for food security can be the common thread that links the different challenges we face and helps build a sustainable future" (José Graziano da Silva, Director-General of FAO, 2012).*

3.1 Introduction

Food insecurity constitutes a major threat in contemporary societies and has both short- and long-term impacts on human survival and well-being. The presumed negative impact of population growth on the availability of food has been discussed on numerous occasions, particularly in the context of developing countries (Malthus, 1798, 1826; McNicoll, 1984; Pimentel et al., 1994; Pimentel et al., 1997; House of Commons, 2007; Sachs, 2008a, 2009; Bongaarts, 2011; SDSN, 2013). However, the field of population and development lacks a systematic analysis of how urbanisation affects contemporary food insecurity risks and how these potential risks are likely to be mitigated by different levels of human development. Yet, urbanisation constitutes a major present-day phenomenon, with more than half of the people in the world already residing in urban areas. At the same time, too often the concepts of food security and insecurity are taken for granted and associated solely with hunger. Frequently, the definition of food insecurity is omitted altogether, thus hampering the progress in adjusting to evolving global challenges (Alexandratos, 2005; Cleland & Sinding, 2005; Alexandratos, 2008; Naylor & Falcon, 2010; Malik et al., 2013). In this context, two fundamental questions arise: What is the nature of associations between urbanisation and food insecurity in contemporary societies? How does human development influence the relationship between urbanisation and food insecurity? In addition to examining these questions, the study has two broad conceptual goals. First, it aims to develop a post-Malthusian analytical framework with a focus on the increasing role of urbanisation; and second, it intends to offer an original framework of the food security concept.

As discussed in more detail in Chapter 2, urbanisation is not entirely a new phenomenon. Historical data show evidence of the rapid increase in the urban population in England from 25.9 per cent in 1776 to 65.2 per cent in 1871, which coincided with significant industrial growth across Europe (Williamson, 1988). Occupational shifts from agricultural to manufacturing sectors were confirmed based on a comparison of the 1801 and 1831 population census data. The changes in occupational structure led to rapid expansion of townships and small cities across England, enabling a constant flow of workers from rural to urban areas. Although agricultural production and related income remained unchanged, the income from trade and transport as well as mining, manufacturing and building continued to rise. Growing towns became home for many new residents or migrants in the 18th and 19th centuries. This was at the time when the major parts of the world were severely affected by hunger and famines (Dando, 2012). Malthus analysed these developments, which led to a set of propositions concerning the potential impact of population growth on food and agricultural production. However, more recent research has shown that urban-rural conflicts over supply of food were common in European history (Walter & Schofield, 1991). By limiting the role of urbanisation to one amongst many positive checks, Malthus overlooked the power of urban growth and its impact on vital resources.

Today, when scholars refer to urbanisation, as the "real population bomb" (Liotta & Miskel, 2012; Buhaug & Urdal, 2013) it is no longer possible to neglect the impact of urban growth on different dimensions of food security. Inasmuch, the motivation for this research is endorsed by a set of observations related to 1) the consequences of the speed and scale of urbanisation in the 20th century, 2) the dynamics of the urbanisation-food security nexus in different developmental contexts, and 3) the continuing and evolving food security threats in the contemporary world. Globally, the percentage of urban population, currently at 52.9 per cent, is projected to increase to 67.2 per cent by 2050 (UN, 2011b). These trends are explained by the unprecedented levels of urbanisation in less developed countries including the rise of megacities in Asia, which currently holds more than half the share of all megacities (UN, 2011b). Urban processes pose critical challenges to both developed and developing countries, albeit often in different ways. Developing countries struggle to adapt their food production systems to meet the needs of people living in urban areas. Adverse climate conditions and natural disasters have further exacerbated the production and availability of food. Moreover, developing countries have been severely affected by the surge in global food prices (Alexandratos, 2008; FAO, 2011). On the other hand, in the urban areas of highly developed nations, the quality and safety of food is likely to pose risks to human health. These developmental differentials will be further investigated throughout the chapter.

It should be acknowledged that a vast body of literature exists on the determinants of nutritional outcomes, including research on underweight and overweight amongst urban and rural households (Griffiths et al., 2004; Mendez et al., 2005; Subramanian & Smith, 2006; Subramanian et al., 2009; Firestone et al., 2011). Worryingly, these studies tend to omit the existing links between food insecurity risks and malnutrition. At the same time, economic and sometimes sociological literature concern themselves with investigating food security in the context of economic growth and military-induced famines (Jenkins & Scanlan, 2001; Scanlan & Jenkins, 2001; Mihalache-O'Keef & Li, 2011). This research often uses long panels and econometric modelling to examine the nature of underlying associations and measures food (in)security in terms of undernourishment and calorie intake. The present study offers a slightly different approach. Anchored in the traditional field of population and development, it provides an analysis of the urbanisation-food security nexus in the context of the contemporary developmental debate. In addition to investigating the potential mitigating impact of countries' level of human development, the study tests the presumed moderating effect of education on the association between urbanisation and food security. Education is a key developmental driver and has been consistently highlighted to be a crucial factor in terms of enabling innovation, facilitating informed choices and stimulating economic growth (Barro & Sala-i-Martin, 1995; Barro, 2002; Becker, 2002; Goujon & Lutz, 2004; Montgomery & Hewett, 2005; Lutz et al., 2008; Samir et al., 2010; Barro, 2013). Regarding the methods applied, this chapter makes use of quantitative techniques with an emphasis on country-level associations. While the primary focus of this chapter is on macro-level relationships, a case study of India is provided in Box 3.1 (p.68). In order to fulfil its objectives, the study is guided by the following hypotheses:

H_1: Countries' rapid urban growth has a negative effect on food security.

H_2: The effect of urban growth on food insecurity risk varies depending on the countries' level of development.

H_3: Countries' education has an attenuating effect on the impact of urban growth on food insecurity risk.

Based on the definition proposed in section 2.3.3, urbanisation is defined as "a process of population concentration, which has important demographic, social and environmental ramifications". Regarding food security, this chapter draws from the FAO's definitions of food security and food insecurity and suggests a slightly revised interpretation of both. Traditionally, food security has been defined as "a situation that exists when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life" (FAO, 2003b, p.28; FAO et al., 2012, p.57). Conversely, food insecurity is thought to exist when people are unable to have physical, social or economic access to safe and healthy food. In the context of contemporary patterns in food consumption, food trade and evolving disease patterns (WHO, 2011), it is timely to re-examine the determinants of food insecurity. For the purpose of this research, levels of human development are determined based on the Human Development Index (HDI). The first two categories of the HDI ("very high development" and "high development") are used to classify countries as developed. The remaining countries (with "medium development" and "low development") are categorised as developing. The group of OECD countries is also referred to in order to complement the discussion and analysis regarding the trends in the highly developed nations. In addition, the list of the United Nations' least developed countries (LDCs) is used as it comprises the most vulnerable nations (UNCTAD, 2011). [12]

This chapter unfolds in the following way. Section 3.2 starts the discussion by the re-conceptualisation of the present-day notion of food security in different developmental contexts. Section 3.3 expands on this conceptual framework and highlights the global interlinkages between urbanisation and distinct food security elements taking into account different developmental trajectories. Referring to the traditional Malthusian feedback loop, a new analytical framework is suggested which focuses on the relationship between urbanisation and food security while incorporating key external factors influencing this relationship. The primary empirical work consists of descriptive analysis and regression modelling of a macro-level dataset compiled for the purpose of this study. The details of the method are spelled out in the relevant section. Conclusions are drawn reflecting on the main findings, with the last section providing a summary of the results, implications for the post-Malthusian framework, and policy recommendations.

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[12] Although the list of the LDCs and the list of countries with low human development (as per the HDI ranking) are very similar they are treated distinctly because they are based on a different set of criteria.

3.2 Re-conceptualising contemporary food security

The first definition of food security was proposed in the wake of the economic recession in the mid-1970s, which was triggered by the oil crisis. After the OPEC embargo in 1973-74, oil prices quadrupled (Gately, 1984). In the same vein, the prices of food and fertilisers increased, putting low-income countries at risk of hindering their economic and developmental progress (World Bank, 2012a). It was in this context that the first definition of food security was established during the World Food Summit in 1974. At that time it was decided that food security implied "availability at all times of adequate world food supplies of basic foodstuffs to sustain a steady expansion of food consumption and to offset fluctuations in production and prices" (FAO, 2003b, p.27). The focus on food supplies was then supplemented by a more balanced approach when, in 1983, the definition was expanded by "ensuring that all people at all times have both physical and economic access to the basic food that they need" (FAO, 2003b, p.27). In the 1980s, the concept was further redefined, which resulted primarily from influential work conducted by the World Bank. The World Bank paper "Poverty and Hunger: Issues and Options for Food Security Developing Countries" highlighted the key role of income and purchasing power of households and nations in the fight against food insecurity (World Bank, 1986a;b). It also distinguished between long-term or chronic food insecurity and temporary food security, which is likely to be caused by short-term inability to purchase food or deficiencies in food production. Chronic food insecurity was referred to as "a continuously inadequate diet caused by the inability to acquire food" (World Bank, 1986b, p.8). The study defined food security as "access by all people at all times to enough food for an active and healthy life" (World Bank, 1986b, p.8). Although the main focus was on financial aspects as the main cause of food insecurity, "healthy life" was adopted in the definition. This implied that food security encompassed more than simply benefiting from access to basic food or preventing hunger.

In 1996, the World Food Summit adapted a revised definition, which is arguably the most commonly used definition of food security to date, even though it has since been updated. The main novel aspect of the revised concept was the inclusion in the definition of the quality of food as well as the issue of satisfying dietary needs and food preferences (FAO, 1996). The definition stated that food security existed when "all people, at all times, have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life" (FAO, 1996). The declaration from the 1996 World Food Summit highlighted the then-existing perception that poverty was the root cause of food insecurity and thus income generation was the main way of preventing it. Poverty, hunger and malnutrition were the main themes of the same document, which also stressed the universal right of people to freedom from hunger.

It was in the 1990s that the concept started to evolve, largely influenced by the writings of Amartya Sen (Sen, 1983b, 1989; FAO, 2003b). In the context of the debate on food and hunger, Sen developed influential ideas of entitlements and capabilities (Sen, 1981). He highlighted that "ownership of food is one of the most primitive property rights" (Sen, 1981, p.434) and that each person was entitled to meet their food requirements. Despite its normative connotation, Sen's concept of entitlements did not imply that each individual had the right to food. Instead entitlements should be interpreted as a person's ability to convert their "endowments" (capital, resources or labour) into goods and services through "exchange entitlements mapping" (Sen, 1981; Devereux, 2001). On the basis of their entitlements, people would be able to gain "capabilities", i.e. an ability to obtain goods or services. Sen argued that famines could take place in a context of general availability of food or even during a time when the aggregate food output was on the rise. For instance, in 1974 during the famine in Bangladesh people died from hunger while per capita food availability was high (Sen, 1983a). In 2001, FAO (2001) amended the definition of food security by including the social aspect of access to food, and this definition was confirmed in 2012 (FAO et al., 2012). While the report officially introduced a number of new indicators measuring different aspects of food security, the overall discourse regarding the concept has not changed. Food insecurity continues to be linked to poverty in the developing countries. The most recent definitions of food security and food insecurity are as follows:

<u>Food security</u> is "a situation that exists when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life."

<u>Food insecurity</u> is "a situation that exists when people lack secure access to sufficient amounts of safe and nutritious food for normal growth and development and an active and healthy life. It may be caused by the unavailability of food, insufficient purchasing power,

inappropriate distribution, or inadequate use of food at the household level. Food insecurity, poor conditions of health and sanitation, and inappropriate care and feeding practices are the major causes of poor nutritional status. Food insecurity may be chronic, seasonal or transitory" (FAO et al., 2012, p.57).

Before highlighting key challenges related to the current interpretation of the concept of food security, it important to point out that the concept comprises four key elements. These are food availability, food access, food utilisation and food stability (FAO, 2009a). In many ways, food availability tends to be the most intuitive aspect of food security, as it is related directly to food production and food supply. Similarly, food stability does not pose conceptual challenges, as it linked to the temporal characteristic of food security, with the assumption that a country is food secure if healthy and nutritious food is available and accessible on a continuous basis. This leads us to the two more complex aspects of the concept of food security. The first one relates to access. Access to food can be either physical or financial, and this is well captured in the recent list of FAO indicators (FAO et al., 2012). In developing countries, infrastructure is often poor, which can in many cases prevent access to otherwise available food. In addition, limited physical infrastructure is likely to incapacitate food traders from reaching customers and may cause farmers to abandon agricultural production and migrate to cities (Martin et al., 2002; Bah et al., 2003). The second aspect of access to food is related to purchasing power. The issue of households' income as the means of buying safe and nutritious food is relevant in both the developed and developing world.

In general in the developed countries research focuses on deprived areas, which may experience inadequate food access. These are often referred to as food deserts and have been analysed in the context of urban poverty, primarily in the United States and Great Britain (Cummins & Macintyre, 2002; Wrigley, 2002; Wrigley et al., 2003; Beaulac et al., 2009). A recent systematic review of literature published between 1966 and 2007 investigating the issue of food deserts in ten countries concluded that income and race-based inequalities in access to food existed in the United States (Beaulac et al., 2009). While the developing countries tend not to link food-related challenges to the concept of food security, the United States Department of Agriculture (USDA) reports data on food insecure households. The 2011 report by USDA highlighted that almost 15 per cent of the households in USA were food insecure (Coleman-Jensen et al., 2011). USDA followed

FAO's definition of food security, quoting food security as "access by all people at all times to enough food for an active, healthy life" (Coleman-Jensen et al., 2011, p.2). At the same time, however, the main focus of the study was on the financial aspect of access to food, thus emphasising this particular element of food security.

While access to food is a key element of food security, the concept would not be complete without comprising an element of food utilisation. This issue is crucial for both developing and developed countries, albeit in slightly different ways. In the developing world, food utilisation has two aspects. First, it is linked to the issue of food safety, which is in turn largely related to hygiene. For instance, street food in many developing nations, technically referred to as the informal food sector (IFS), is a cause of serious health risks. Diseases triggered by consumption of unsafe food include hepatitis, typhoid, cholera and tuberculosis (FAO, 2007a). In addition, street food is often characterised by a lower level of nutrients and disproportionate quantity of hydrogenated oils (FAO, 2009b). Second, developing countries and regions suffer from a high prevalence of overweight and obesity, which often coincide with hunger and undernutrition. A study by Mendez et al. (2005) concluded that amongst females overweight exceeded underweight in most developing countries. In the developed world, overweight and obesity are the primary food insecurity risks related to food utilisation. Key aspects of food utilisation are related to the nutritional transition theory. A flagship paper by Barry Popkin (1993) on nutritional patterns and transitions highlighted the role of urbanisation as a contributor to degenerative diseases. The consumption patterns in urban areas involve fast food and fast food-like food, resulting in worryingly high obesity rates. The 2012 Obesity Update by the OECD reported that on average 17 per cent of the adult population in OECD countries were obese and over 21 per cent of children aged 5-17 were obese or overweight (OECD, 2012b).

The simple conceptual framework of food security presented in Figure 3.1 follows on from the above discussion. As highlighted in this section, different food security components can carry specific food insecurity risks, which are linked to the level of countries' development. Food availability, food access and food utilisation can be thought of as part of a food consumption cycle, or food feedback loop. Food stability complements the concept of food security by highlighting the issue of sustainability. All these components contribute to the overall food insecurity risk. At the other end, food insecurity outcomes are linked to malnutrition, including undernutrition and obesity, while in extreme cases they might result in hunger. All these individual outcomes contribute to the global burden of disease, which in turn may lead to death. Thus, food security components can be understood as distinct factors contributing to the outcome of food security. A failure to satisfy any of these elements can result in the state of food insecurity (outcome). Both food insecurity components and outcomes are a useful concept, because they allow a more straightforward measurement of both micro- and macro-level food insecurity. The discussion concerning measurement will be the subject of the data and methods section. In order to gain a deeper insight into the overall concept of food insecurity in the context of rapid urbanisation, the next section provides a detailed discussion of the complex interlinkages between the two phenomena.

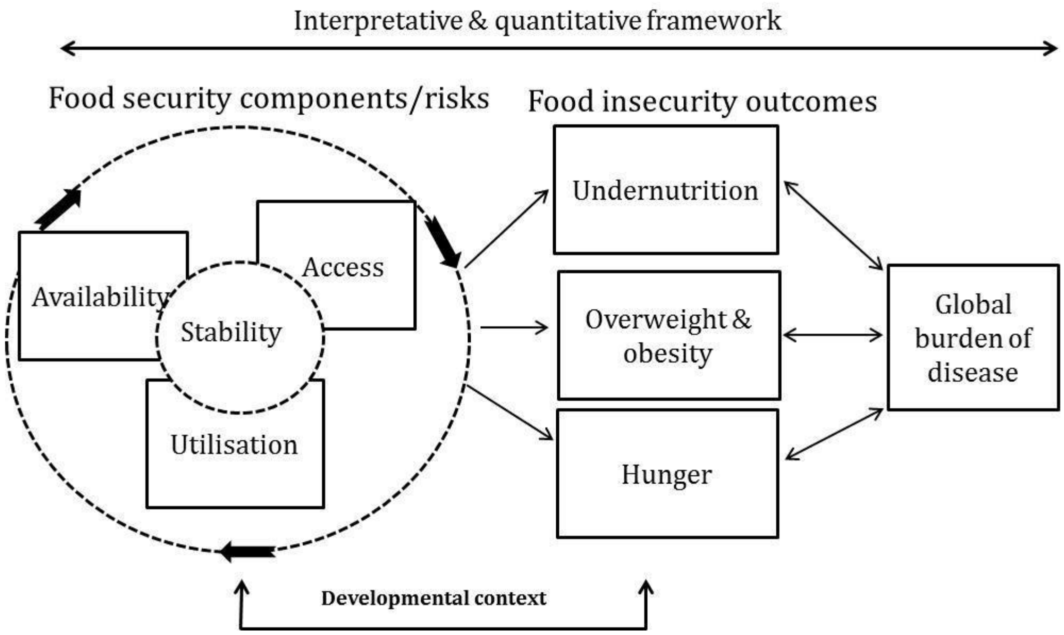

Figure 3.1 Conceptual framework of food security.

Note: Author's conceptual framework expanding on FAO's definition of food security.

3.3 Urbanisation and food insecurity in different developmental contexts

In the 21st century's world of exchange and consumption, starvation and hunger remain a major threat to human life and health. In the first decade of the century, 24,000 people died of starvation every day (Dando, 2012). While lack of food results in hunger, lack of safe and nutritious food causes food-borne diseases and general ill health. In the developed world, and increasingly also in developing countries, the dangers of malnutrition resulting from overweight and obesity have become an additional dimension of evolving food insecurity concerns. The goal of this section is to provide a discussion of interrelationships between urbanisation and each aspect of food security, i.e. food availability, food access, food utilisation and food stability. Reflecting on the food consumption loop presented as part of the conceptual framework in section 3.2, the issues related to availability of food and food access will be discussed first, followed by food utilisation and the problem of sustainability. While the primary focus of the discussion will be at the country level, the same arguments are likely to apply to regions in large population countries, such as India, China or Brazil.

3.3.1 Food availability

In terms of food availability, urbanisation constitutes a challenge, taking into account evolving consumption patterns as well as food production and food supply processes. Rapid urban growth and an increasing number of megacities imply that more food will have to be available to people who live in an environment which has traditionally been perceived as inadequate for agriculture. Almost all urban dwellers are net buyers of food, which is also, more surprisingly, the case for small-scale farmers (FAO, 2011). Rural-urban migration trends contribute to changing nutritional habits and food supply strategies. At the same time continuing urban sprawl makes it often difficult to set clear boundaries between urban and rural areas. Land, including in urban peripheries and adjacent rural zones, gains value and farmers are often likely to sell land for profit, which leads to further urban expansion. As cities continue to grow, water – a key resource for agricultural production – is becoming scarcer and often wasted because of excessive domestic and industrial use.

As highlighted in Chapter 2, modernisation theory states that rural-urban migration and urban growth have a positive long-term impact on the economic growth of a country (Bradshaw, 1987). While this process is likely to operate in the long run (Ravallion et al., 2007), in the short to medium term, in many less developed countries, which suffer from weak food production systems, internal migration to urban areas can put additional strain on food production. The urban bias theory argues that, due to the pressure exercised by urban-based groups, many states implement policies that benefit urban centres. This in turn creates disparities between cities and countryside (Lipton, 1977). In the context of agricultural production, the decision-making is likely to vary depending on the country's natural resources, level of development (including technological advancement), and trade opportunities.

In order to gain a better understanding of the developmental differentials in the urbanisation-food availability nexus, graphical illustration of the historical trends is presented in Figure 3.2. As can be observed from the graph, in the last fifty years the proportion of urban population in the least developed countries almost tripled. At the same time the OECD member states, which were already highly urbanised in the 1960s, continued to experience urban expansion. Even though urban growth was faster in the LDCs, the increase in their agricultural yield amounted to only 72 per cent, while in the OECD group it exceeded 147 per cent. In developing countries, cereal intake[13] constitutes 56 per cent of total calories, which translates into 173 kg of cereal consumption per person per year (FAO, 2003c). On the other hand, in developed countries, the proportion of cereals consumed is smaller. However, the developed nations also consume cereals in an indirect way through consumption of livestock (Koohafkan et al., 2008).

Globally, four main solutions have been identified to tackle challenges related to food availability in the context of increasing urbanisation. These are: 1) increasing food production and agricultural yield through technological innovation, 2) changing food habits, 3) shifting food production to cities by means of urban agriculture, and 4) the quest for new land. Each of these phenomena operates in different ways in highly developed and developing countries. Increasing food production through technology has been the most obvious way of ensuring that the global food demand was met. Historically, until the green revolution food production was mainly farm-based and reliant on local output (Gopalan, 2001). In the post-Second World War golden age of capitalism, agriculture became increasingly industrialised and based on science and technology. While this trend resulted in an overall greater food yield, it also created new challenges. High income and technologically advanced nations were able to produce large quantities of food and export it to developing countries. This in turn had a detrimental effect on local agriculture in the developing world (Wilkinson & Scott, 2012). Amongst many social consequences of importing food one can count an increased rural-urban migration.

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[13] Cereals were used to approximate food because cereals are the main components of the human diet (in terms of kilocalories).

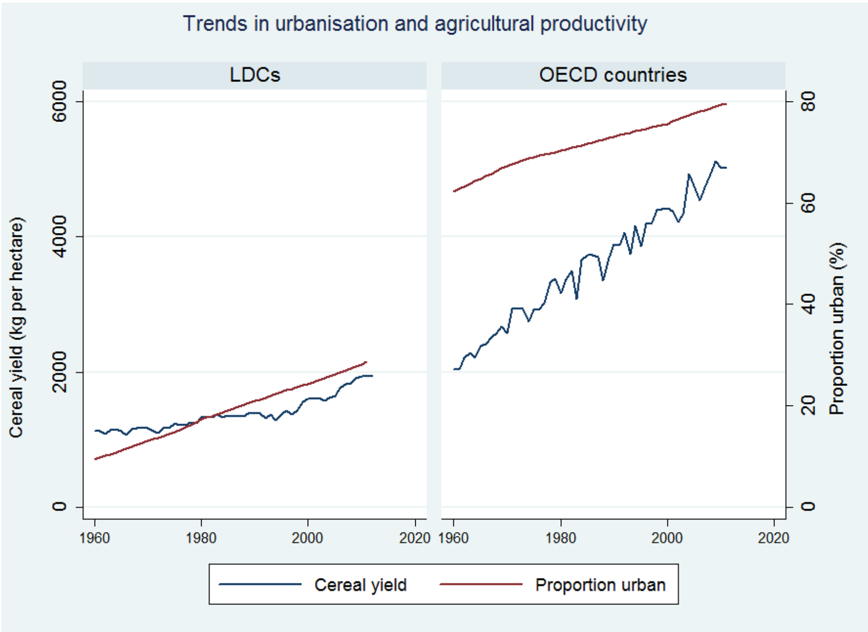

Figure 3.2 Trends in urbanisation and agricultural productivity – OECD countries and LDCs (1960-2010).

Data source: World Development Indicators (WDI), the World Bank.

In addition to technological advancements, changing food habits contribute to the overall demand for specific food products. Highly processed food is increasingly popular and demand for meat continues to grow. In the context of overall availability of food, finding new sources of nutrition is becoming an important challenge. Hence, arguably, the growing focus on edible insects as a source of nutritious diet constitutes an emerging development which is likely to affect both availability of food and consumers' eating habits. While in many developing countries insects have traditionally constituted part of regular diets, urbanisation poses challenges to larger-scale insect consumption, in at least two ways. Firstly, urban dwellers are less willing to consume insects due to westernisation of urban areas (FAO, 2013a). Secondly, the process of urbanisation results in decline and sometimes extinction of insect populations (Fattorini, 2011), although some species have been able to adapt to urban habitats (McKinney, 2006).

Although more efficient farming techniques and overall industrialisation of agriculture have allowed greater agricultural productivity, another important phenomenon in the context of rapid urbanisation and food availability is the growing importance of urban agriculture, occurring primarily in smaller cities and peri-urban areas. It is estimated that today around 15 per cent of food is grown in urban areas (USDA, 2013), and these trends are on the rise. Urban agriculture is becoming increasingly popular on a global scale. Scholars argued that its role substantially varied depending on countries' developmental context (Pearson et al., 2010; van Leeuwen et al., 2010). Traditionally, it has been maintained that, in the developing countries, urban agriculture is a means to decrease food insecurity, while in highly developed countries its purpose is to provide leisure and recreation (Pearson et al., 2010). However, following on from the conceptual framework of food security (Figure 3.1), it can be argued that, although the rationale behind urban agriculture varies by developmental contexts, its overall impact on food insecurity cannot be neglected. In the developing world, urban agriculture increases the overall food access, while in the highly developed nations its role is primarily linked to food utilisation. These distinct aspects of urban agriculture will be further highlighted in the relevant sections.

Finally, one of the most important issues related to food availability in the context of rapid urbanisation is the amount of land available for agriculture. Logically, urban sprawl has a negative impact on agricultural land. As cities grow and real-estate investments continue to acquire more land for commercial developments, farming land shrinks. For instance, an analysis of the city of Shijiazhuang in China (the capital of Hebei province) shows a major increase in urban land use to the detriment of crop land (Xiao et al., 2006). Between 1934 and 2001, the city expanded from 6.31 km^2 to 165.5 km^2, which constituted an average rate of 2.4 km^2 per year. This triggered important changes in the management and use of land (Xiao et al., 2006). While the example of Shijiazhuang, and Chinese cities in general, is likely to constitute an extreme case, it provides a useful illustration of the global decline in the area harvested.

Figure 3.3 provides a graphical overview of the global trends in area harvested per capita. By definition, area harvested refers to "the area from which a crop is gathered" (FAO, 2013b). As shown in Figure 3.3, cereals are used to approximate overall crops. The graphs illustrate that, as proportion of urban population continued to increase, overall area harvested per capita was steadily declining. Globally, area harvested per capita is now twice as small as it was in 1960. LDCs observed a similar negative trend and their current mean area harvested per capita is only slightly larger than the global average. When considering regional differentials, it can be noted that all regions experienced a per capita decline in area harvested, although at various levels. In North America, for example, area harvested per capita was almost 400 hectares in 1964, but had declined to 205 hectares in 2010. In Asia on the other hand, area harvested per capita was around 156 hectares in 1960 and it now amounts to 80 hectares (FAO, 2012a). Thus, while the trends are similar across different world regions, discrepancies exist in terms of the actual size of the area harvested and agricultural yield across geographical regions. Most developed countries, including North America and Europe, continue to benefit from highest cereal yield as well as highest area harvested per capita. It is sensible to say that urbanisation processes in these countries have been accompanied by technological advances and structural changes, which contributed to greater efficiency in agricultural production. As highlighted previously, urbanisation in the developing countries is often accompanied by poor planning, which is likely to increase the existing food insecurity risks in these nations.

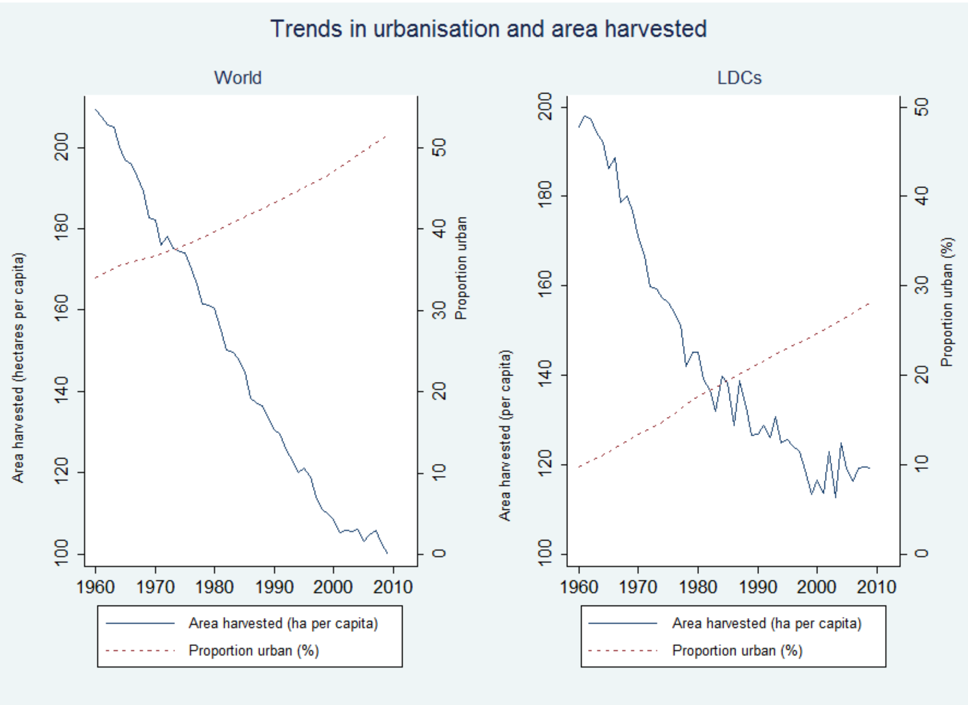

Figure 3.3 Trends in urbanisation and area harvested – global and LDCs (1960-2010).

Data source: FAO and WDI. Area harvested refers to cereal crops only.

The developed-developing differentials are apparent when it comes to land ownership and land use. In recent years, outsourcing food production through land lease has emerged as a phenomenon through which some countries and regions strive to protect themselves against food insecurity (Cotula et al., 2009). The recent global financial and food crises sparked controversies on land-lease deals between land-scarce rich countries and land-abundant poor countries (Daniel, 2011). It has been widely reported in the press that the Qatari Government leased 40,000 hectares of land from Kenya to grow vegetables and fruit in exchange for constructing a port on the Kenyan island of Lamu (Cotula et al., 2009). In June 2008, the United Arab Emirates purchased 324,000 hectares in Pakistan's regions of Sindh and Punjab (Daniel, 2011). China and India are also reported to have leased land in Ethiopia. The 2009 collaborative report by FAO, International Fund for Agricultural Development (IFAD) and International Institute for Environment and Development (IIED) highlighted that since 2004 almost 2.5 million hectares of over 1,000 hectare land allocations were documented in five African countries, i.e. Mali, Madagascar, Ethiopia, Ghana and Sudan (Cotula et al., 2009).

Many of the land-seeking countries include highly urbanised Gulf states. In Qatar, the urbanisation rate exceeded 99 per cent, in Kuwait it amounts to 98 per cent, Saudi Arabia is urbanised at 82 per cent, while in Oman the urban proportion exceeded 73 per cent (UN, 2011b). While land leasing may provide some immediate solutions to agriculturally disadvantaged nations, at the same time it poses severe risks. At the local level, land sale/lease in poor countries reduces the need for local workforce, and can lead to dispossessions and displacements. In addition to international land deals, domestic land grabbing can be motivated by a number of reasons spanning from real-estate development, corporate investments and ethnic conflicts. It is frequently eased by the lack of formal land tenure rights. Regardless of the reasons behind land grabs, it contributes to decreasing food availability in the "lending" country.

3.3.2 Food access

As previously stated, two key aspects of access to food are physical food access and financial food access. When it comes to physical access, urbanisation is likely to have a positive impact on food security. In highly developed countries, in general, physical food access is not a concern. Individuals who are unable to access grocery shops often have the possibility of buying food over the internet with a home delivery option. This facilitates food access for the sick and disabled. In the developing countries, on the other hand, physical access is often a major problem. In many African countries, including Ghana, farming is predominantly subsistence based (Sarpong, 2006; FAO, 2012b). This is due to the lack of tenure rights, lack of financial means needed for commercial agriculture and lack of adequate infrastructure. In this context, urbanisation is likely to be beneficial, if not driven by narrow interests of urban elites.

In addition to physical food access, financial access plays a great role in ensuring food security. Research has shown that urban dwellers are likely to buy more than 90 per cent of their food (Ruel & Garrett, 2003) and therefore food prices are a major determinant of whether foodstuffs can be accessed. Residents of metropolitan areas such as Cairo, Lima, and Maputo purchase between 92 and 98 per cent of their food (Ruel & Garrett, 2003). Although urban agriculture can supplement the diet of urban residents, in many cases such options are not available to the poorest urban communities. Often the urban poor engage in informal exchange of services and commodities in return for food, which is likely to be of low quality. In the developed world, food prices can also be a cause of concern. As previously mentioned, the 2011 US Population Survey carried out by the US Census Bureau indicated that only 85 per cent of households in the United States were food secure (Coleman-Jensen et al., 2011). The largest proportion of households identified as food insecure resided in the largest cities of each metropolitan area (Coleman-Jensen et al., 2011). In addition, the largest cities contained a comparatively high rate of households with food insecure children (12 per cent).

In many of the countries geographically located in the Caucuses or Central Asia, which are mostly categorised as medium developed, access to food could be a societal problem. A 2006 World Bank report highlighted that poor populations in the Eastern Europe and Central Asia (EECA) region, in particular those residing in urban areas, had to adopt food reduction strategies in order to meet their minimum livelihood requirements (World Bank, 2006). The situation of the urban poor has been further deteriorated by the economic crisis and the increasing price volatility of main food products (FAO, 2010, 2011; Dando, 2012). While, in the long term, rising prices might present an opportunity in a sense that they could trigger an increased investment in the agricultural sector (FAO, 2011), such investments require capital and might not be feasible in the least developed countries. The Asian Development Bank (ABD) warned that rising food prices may threaten the economic growth in Asia. According to the ADB, in 2011, in many Asian countries food prices increased by 10 per cent (BBC, 2011). In addition, recent floods in South Asia, including in Thailand and Indonesia, exacerbated these countries' vulnerability to food insecurity risks. Similarly, countries in Latin America, including Bolivia, Honduras, Dominican Republic and Guatemala, were hit by a surge in food prices triggering inflation in these nations above 5 per cent (Wroughton, 2011).

The LABORSTA database by the International Labor Organization (ILO) allows comparison of the increase in food prices by countries' level of development (Figure 3.4). Because LABORSTA does not provide country groupings, based on the HDI ranking, ten most developed countries and ten least developed countries are selected. The indices are then averaged in order to present the overall trends. In the least developed group (ten countries with lowest HDI), we provide an average trend as well as the mean trend which excludes Guinea. Guinea is treated as an outlier because during the last decade it experienced disproportional hikes in food prices, with its food index rising from 114 in 2002 to 656 in 2010. It has been reported that the food uncertainties were amongst the causes of riots and political unrest in the country. However, even if Guinea is excluded

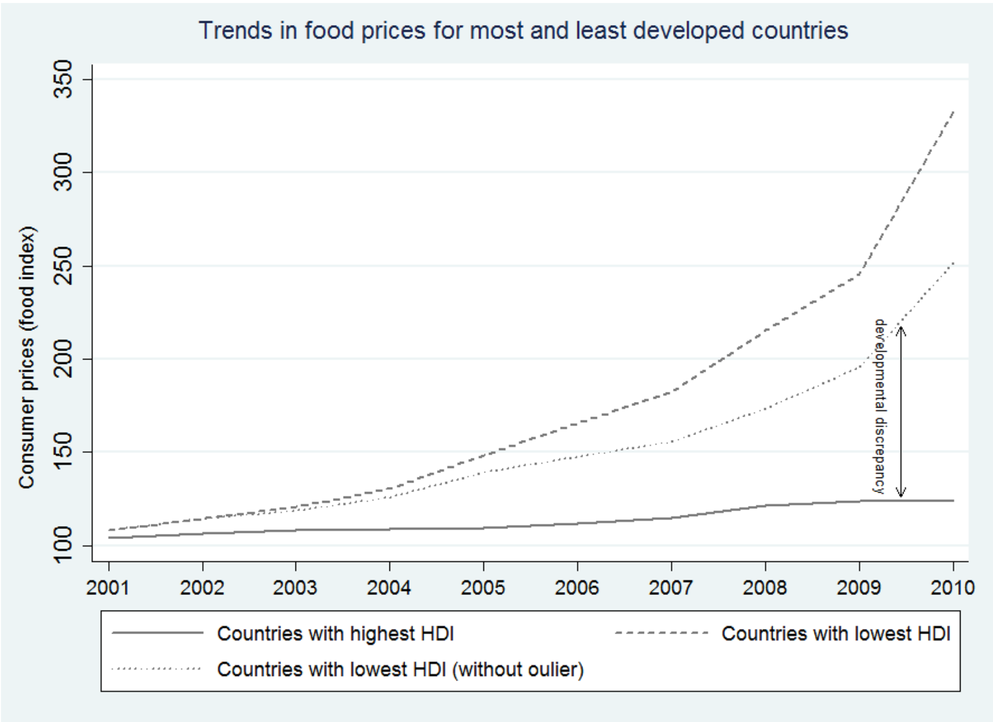

Figure 3.4 Trends in food prices – most and least developed countries (2001-2010).

Data source: LABORSTA, ILO. Food indices include non-alcoholic beverages.

from the analysis, the overall trends confirm that price volatility has been a much greater challenge in the countries with lowest levels of development. This is likely to be related to the international trade system which favours developing nations (Dando, 2012). In the context of increasing price volatilities, many urban poor, who often reside in slum areas and suffer from a lack of safe drinking water and health facilities, face additional challenges accessing food.

3.3.3 Food utilisation

Food utilisation is another integral aspect of food security because it refers to food quality. The official FAO definition of food utilisation states that "utilisation is commonly understood as the way the body makes the most of various nutrients in the food" (FAO, 2008, p.1). The concept highlights the importance of the diversity of diet, food preparation and feeding practices (FAO, 2008). By stressing the crucial role of nutritious and healthy food, food utilisation encompasses such factors as safe water and sanitation.

As previously highlighted, because urban residents are particularly vulnerable to volatile food prices, they are often forced to reduce other expenditure in order to meet their basic food requirements. In the developing countries context, poor urban dwellers are thus at risk of consuming low-quality food, including often unhygienic street food, and are therefore exposed to danger of disease (Matuschke, 2009). On the positive side, the informal food sector and street food can contribute to increasing food security by providing affordable food (FAO, 2007a). On the other hand, however, the informal food sector can trigger food insecurity risks resulting from the low quality of the food consumed and lack of hygiene during food preparation, including the cleanness of vending stands. Handling of food with bare hands in places that lack immediate access to clean water may result in transmission of diarrhoeal pathogens (Mensah et al., 2002). Because the food-serving stage is so critical, many urban poor incur food infections and are at risk of life-threatening diseases. In addition, because vending stands are often unprotected, insects, including disease-bearing flies, are likely to access and contaminate foodstuff.

Another factor impacting food quality in rapidly urbanising developing countries is environmental contamination. Many countries, including Kenya, experience challenges with high levels of lead in water and soil, which has a negative impact on food safety

Box 3.1 Underweight, overweight and obesity amongst Indian females: the role of urbanisation and levels of development.

With its rapid population growth, urbanisation and differentiated development, India is a unique case study when it comes to research on food security. Today over 30 per cent of India's population reside in urban areas, which translates into 388 million urban dwellers. At the same time, Indian urbanities are highly diverse ranging from expensive residential areas and international urban centres to largely deprived slums. Simultaneously, according to official FAO food insecurity statistics (2010-12), 17.5 per cent of the Indian population are undernourished and India's depth of food deficit (see notes below for definition) is estimated to be 125 kcal per capita per day. Previous studies confirmed that in the Indian context the relative risk of underweight is lower in urban areas, while the opposite is true for obesity and overweight. In addition, research found that different socio-economic attributes have a mitigating effect on these relationships (Griffiths & Bentley, 2005; Subramanian et al., 2009; Kalra & Unnikrishnan, 2012).

The results of regression analysis of the 2005-06 Indian DHS data (Figure 3.5) show that overall, in the most developed regions, the differences in relative risk ratios (RRR) are considerably smaller as compared to medium developed and least developed regions. More specifically, in the highly developed context the relative risk of underweight is between 22 and 15 per cent lower in urban areas as compared to the same risk in rural zones. On the other hand, least developed regions show steady linear decline in the values of RRR as urbanisation progresses, while medium developed regions demonstrate greatest disparities in terms of risk of underweight between rural areas and large cities. When it comes to the relative risks of obesity, the trends are even more pronounced. The greatest spatial inequalities can be observed in the least developed categories, where the relative risk of obesity in towns is more than 5.3 times higher as compared to that in the countryside.

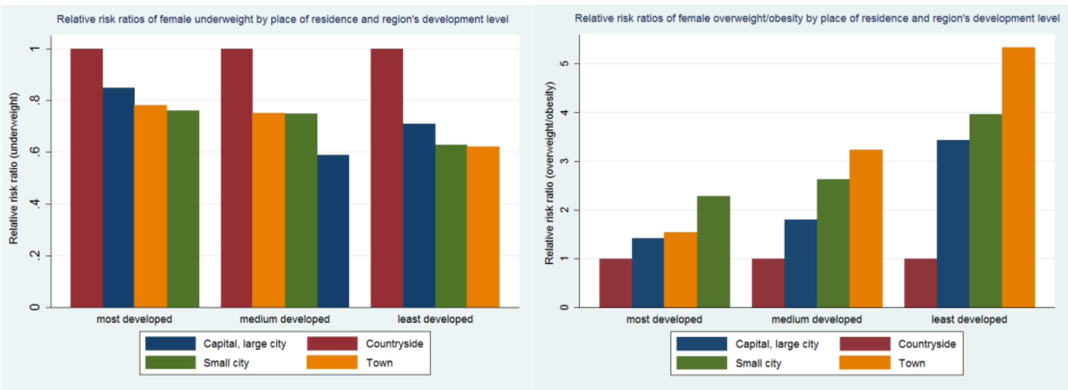

Figure 3.5 Relative risk ratios of female underweight and overweight/obesity by type of residence and region's development level.

Notes: Results of the multinomial regression used for this figure are reported in Appendix C.

According to FAO (2013b), "The depth of the food deficit indicates how many calories would be needed to lift the undernourished from their status, everything else being constant. The average intensity of food deprivation of the undernourished, estimated as the difference between the average dietary energy requirement and the average dietary energy consumption of the undernourished population (food-deprived), is multiplied by the number of undernourished to provide an estimate of the total food deficit in the country, which is then normalized by the total population".

(Makokha et al., 2008). Chinese and Indian megacities and other urban areas suffer from high air and soil pollution, which affects the nutritional value of agricultural produce. Globally, sixteen out of the twenty most polluted rivers are located in China (McBeath & McBeath, 2010). Water pollution caused by industrial and human waste as well as chemical pesticides leads to soil contamination (McBeath & McBeath, 2010). In addition, wastewater irrigated crops are likely to contain heavy metals and pesticide residues, which can have a dramatic impact on human health (Khan et al., 2008; Wang et al., 2013). Research conducted in Jiangsu province in Eastern China found that heavy metal concentrations were also present in poultry and livestock (Cang et al., 2004).

A crucial aspect of food utilisation in both developing and developed countries pertains to the quality of food, which is linked to the food supply system. Amongst the consequences of rapid urbanisation there has been a shift in production patterns of food. These include the emergence of and rapidly growing trends in trade and consumption of processed food (Popkin & Nielsen, 2003; Akram-Lodhi, 2008). It has been proved that urbanisation is highly correlated with access to processed foodstuffs, which have higher sugar levels (Popkin & Nielsen, 2003). In addition to sugar and artificial sweeteners, processed food tends to contain artificial colouring agents, hydrogenated fats, preservatives and chemical pesticides. In the contemporary world, processed food is often the most accessible type of food, in terms of both physical proximity and price. Employees and students in busy urban centres are thus highly likely to be at risk of consuming unhealthy products. Urban poor are also susceptible to choosing cheap processed food. A major concern that arises when observing the changes in consumption patterns linked to urbanisation is a shift towards high energy food (Kearney, 2010).

The challenges related to a greater consumption of processed food coupled with sedentary lifestyles in cities result in serious health risks. As already pointed out, obesity and overweight have now become causes of death for more than 2.8 million people a year. WHO reported that in Europe, the Americas and the Eastern Mediterranean region[14] more than 50 per cent of women are overweight (WHO, 2011). While the obesity epidemic has been traditionally considered to be a health concern in the developed countries, today the overall burden of obesity and chronic diseases is greater in developing countries (Malik et

[14] Regions defined by WHO.

al., 2013). Because of urban growth, but also globalisation, many developing countries suffer from a double burden of undernutrition and obesity. Vast evidence suggests a positive relationship between high proportion of urban dwellers in a country and obesity prevalence. A recent article in The Lancet reported that between 1975 and 2003 male obesity in Brazil tripled and female obesity doubled (Cecchini et al., 2010). Similarly, in China between 1991 and 2006 the rates of overweight grew from 13.5 to 26.7 per cent and obesity rates tripled, reaching 3.2 per cent (Cecchini et al., 2010). It has been shown that in China urban residency is highly associated with a greater risk of diabetes (WHO, 2011). As previously highlighted, urban slum dwellers continue to suffer from undernutrition and even hunger (although the burden of NDCs is also growing rapidly in slum areas). Sometimes, the risks of obesity and underweight coexist not only within the same countries or communities, but also within the same households. In addition to the long-term risks resulting from food utilisation, populations in both developed and developing countries are likely to be affected by temporary food insecurity, which is the issue discussed in the next section.

3.3.4 Food stability

Stability in food supplies and access to healthy food is the fourth aspect of food security. Food stability can be threatened by natural disasters, wars and conflicts as well as food dependency due to insufficient domestic production. At the household level, a lack of food stability can occur because of challenges in physical or economic access to food. A recent report by the International Federation of Red Cross and Red Crescent Societies (IFRCRCS) discusses disaster risks in urban areas (IFRCRCS, 2010). While in the developed countries cities are likely to be well organised and thus disaster preparedness is generally high, in the developing world the urban poor are at risk of food insecurity caused by disastrous events. Sub-standard housing constructions, housing density and inadequate disaster preparedness in many developing countries contribute to large human casualties. In this context, the risk of urban food insecurity increases.

In addition, as urban residents rely on paid employment to provision themselves with basic commodities, a shock could entail job loss or death of the primary income earner, thus threatening households' access to food. Unemployment or otherwise sudden drop in income may lead to difficulties with meeting basic livelihood needs. As per 2013

EUROSTAT data, in all months of 2012 the EU27 suffered from above 10 per cent unemployment rate. In some countries, like Greece and Spain towards the end of 2012, the unemployment rate exceeded 25 per cent. At the same time, youth unemployment is reported to be even higher. A recent press release from the United States Senate's Budget Committee mentions that in the US one of six Americans was on food stamps (United States Senate, 2012). While in the developed countries individuals and households often benefit from social safety nets, this is mostly not the case in the developing nations. Although social and community networks tend to be stronger in the developing world, if the scale of financial loss is high the consequences can be dramatic.

Finally, at the national level food dependency can pose severe challenges. In the long term, importing food can be problematic because countries are reliant on good business relations with trading partners as well as efficient transport links. Highly urbanised nations with little arable land and/or with adverse climate conditions are particularly prone to food dependency. This is the case of some of the countries and regions that rank highly in food imports, such as Hong Kong, Singapore, Qatar, United Arab Emirates and Saudi Arabia. The Gulf region in particular has experienced a very rapid urbanisation following the discovery of oil and gas in that region. The Gulf Cooperation Council (GCC) countries have undergone transformation from nomad and rural societies to highly urbanised societies (Costello, 1977; Kapiszewski, 2001). High urbanisation rates combined with rapid population growth and adverse geographical conditions put countries at risk of water shortage and food insecurity. As previously discussed, in this context many food dependent nations strive to secure land abroad in order to grow food for their domestic markets. Investigating the conceptual links between urbanisation and food insecurity is the theme of the next section. The focus of the discussion will be on reorienting the traditional Malthusian framework through emphasis on the key contemporary challenges affecting food security.

3.4 The contemporary urbanisation-food security framework

Following the line of argument in this chapter, the impact of urbanisation on food security is placed as the central part of the revised analytical framework (Figure 3.6). The urbanisation-food security association is moderated by the human development environment. This urbanisation-development-food security nexus is in turn influenced by a set of additional phenomena, which are conceptualised as exogenous factors. These include 1) population stock; 2) geographical habitat; 3) globalisation; and 4) disastrous events. It is acknowledged that separate associations may exist between each of these factors, although this remains outside of the focus of the present study. The suggested high-level conceptual framework emphasises the key global relationships while recognising that additional elements could be incorporated at specific levels of analysis.

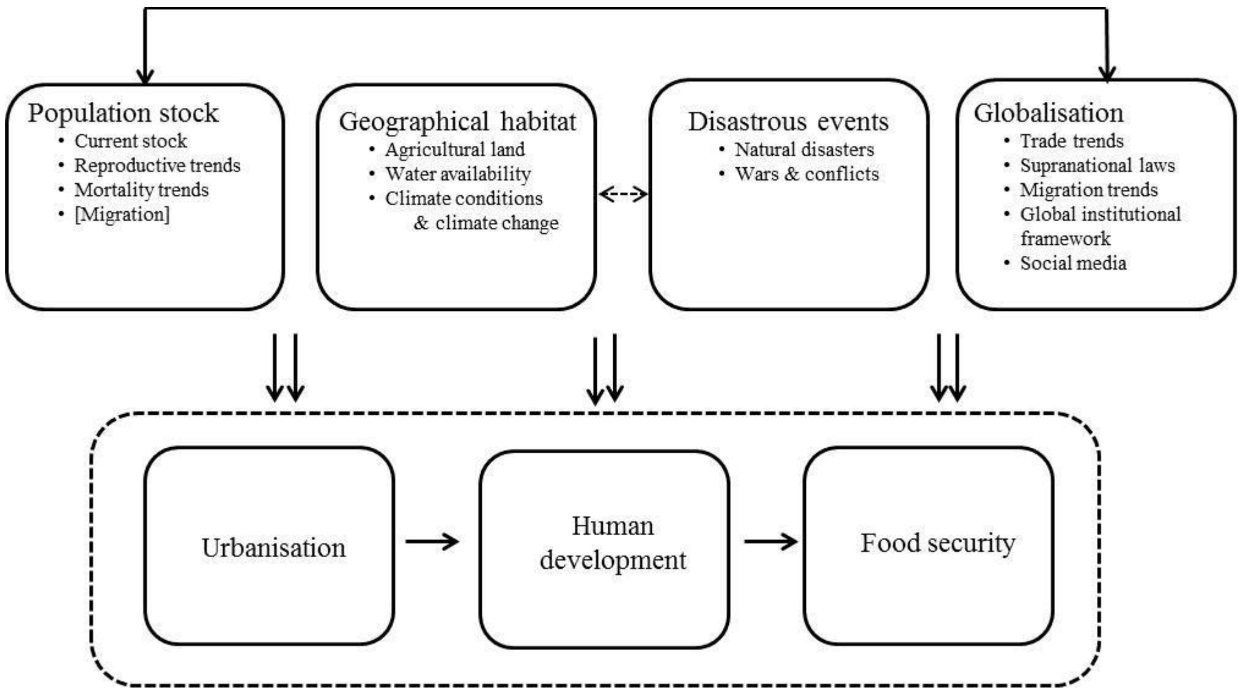

Figure 3.6 Contemporary framework presenting associations affecting food security.

Population stock is understood as the overall number of people. The global population stock at any point of time is influenced by reproductive trends and the patterns in mortality rates. Even though migration influences the country-level or community-level population size, it has little significance globally. Malthus argued that emigration could not be seen as a continuous solution to the inevitable laws of population, because any immediate vacuum caused by emigration would be soon filled (Malthus, 1826; Ghosh, 1963). More explicitly, the laws of population implied that such a vacuum could not last due to increasing numbers of births as well as immigration from other parts of the world. While today fertility rates continue to decline regardless of the overall means of subsistence, increasing international mobility supports the Malthusian argument regarding the overall temporary impact of migration.

Population stock has a considerable impact on the association between urbanisation and food security. Rapidly growing overpopulated urban areas are generally more susceptible to food insecurity risks. The unique link between population size and urbanisation takes place through the process of rural-urban migration. In this context, the increasing proportion of urban residents combined with a larger population size can trigger concerns about the availability of and access to natural resources. In developing countries, in particular, urbanisation-population growth dynamics tend to put increased pressure on peoples' livelihoods. As previously discussed, poor urban households are often at a disadvantage when it comes to access to food, which can be exacerbated by large household size and a growing number of urban settlers. The potentially negative impact of a large population stock can, however, be mitigated by the overall level of countries' human development and developmental drivers. Thus in the most populated countries a generally negative effect of urbanisation on food security can be reduced or elevated by citizens' education and disposable income.

Similarly to population stock, globalisation plays a key role in terms of affecting the urbanisation-food security nexus. According to the OECD's definition, globalisation refers to "an increasing internationalisation of markets for goods and services, the means of production, financial systems, competition, corporations, technology and industries" (OECD, 2012a). Interpreted as such, globalisation encompasses economic expansion, trade and cross-countries investments, as well as transportation links and the institutions representing global governance. These institutions can be either international, like the World Bank or the International Monetary Fund (IMF), or regional, e.g. the European Union and the Association of Southeast Asian Nations (ASEAN). Beyond established institutions, global governance incorporates multilateral and bilateral agreements and regulatory frameworks. Globalisation is not limited to international elites, but touches on different aspects of human lives. As such, globalisation influences the urbanisation-food security association in different ways. It has an impact on food availability, including food supply, because of trade and knowledge exchange between countries. From a political perspective, international trade has been referred to as a "vital component in the food security picture" (Lamy, 2011). Logically, by means of trade and given a developed infrastructure, transported food stocks can easily satisfy external demand. Lack of trade can have severe consequences on food security, which could be recently observed through the example of plunging rice prices. The rice market has particularly suffered from the 2008 food crisis because of the fact that only a small percentage of rice was traded internationally, which further increased its price volatility (Lamy, 2011). In addition, cross-national information exchange, including through social media, can have a differentiated impact on both urban trends and food security. Access to the internet can empower people and facilitate decision-making, including with regard to their potential migration decisions and food choices.

As part of the globalisation process, international and regional governance can have considerable impact on urbanisation and food security. Agriculture is increasingly perceived as a market-oriented economic sector, which has a number of implications (McMichael, 2005). In this context, the global and regional agreements related to trade in food affect food security patterns in both importing and exporting countries. On the one hand, an institutionally imposed tariff system influences which food products are sold on which markets and at what price. This in turn has implications for local agriculture, which often fails to be competitive with foreign produce. Dando (2012, p.412) highlighted that the current tariff system creates monopoly of food supplies which acts against developing countries. On the other hand, the internationalised agricultural market can influence urbanisation trends. In developing countries, this is likely to take place through farmer displacements which contribute to urban growth.

Geographical habitat, including climate change, constitutes another dimension when it comes to assessing the relationship between urbanisation and food security. Historically, urban settlements have been created in places with easy access to water, for instance in ancient Mesopotamia cities flourished on the shores of the Euphrates River. Countries such as Russia or Canada, which suffer from harsh weather conditions primarily through long winters and low temperatures, experience lower urban growth rates, with Russia currently having a negative urban growth rate of -0.33 (UN, 2012). In addition, there are many interlinkages between urbanisation, climate change and food security (Satterthwaite, 2009). Because climate change can influence agricultural activities, farmers may be forced to migrate to urban areas, thus stirring further urban growth. On the other side, affected by climate change urban areas are likely to influence demand on different types of agricultural produce (Satterthwaite, 2009).

Disastrous events, such as floods, hurricanes or civil unrest, can potentially have an adverse impact on food security. Disastrous events are closely linked to countries' geographical conditions, especially when it comes to natural disasters. The World Food Programme (WFP) lists nature and war amongst the causes of global hunger. FAO defines food emergency as "a disaster-induced shortfall in its aggregate food supply relative to its consumption requirements in a given year cannot be fully covered by the country's own resources and, therefore, it needs external food assistance" (FAO, 2003a, p.39). In the last three decades Liberia has suffered from two civil wars, which have highly contributed to the country's food insecurity. Almost 40 per cent of Liberia's children under the age of five suffer from stunting (Sutter & Cashin, 2009). In Japan, the 2011 tsunami caused serious concerns about food security, not only because of its effect on agricultural land and forests, but also through danger of contamination due to nuclear leaks at the Fukushima Daiichi Nuclear Plant (Johnson, 2011). In addition, the production of Japan's main crop – rice – was heavily affected in tsunami-hit areas.

All the elements discussed above constitute important factors influencing the urbanisation-food security nexus, albeit in different ways. Today, as the majority of the world's population live in towns and cities, it is timely to re-analyse the nature of these new relationships. Making use of the classifications and indicators developed by international organisations, quantitative analysis will allow conducting a systematic enquiry.

3.5 Method and measurement

3.5.1 The dataset

The dataset comprises macro-level statistics including information about 174 countries. It has been compiled based on the 1990-2010 time period with five distinct time points (1990, 1995, 2000, 2005, and 2010), thus constituting a short panel. The complete list of variables and their definitions and sources is provided in Table 3.1. The choice of the outcome variable follows on from the conceptual framework presented in section 3.2 and the discussion regarding specific food insecurity risks at the country level. While more detailed description of the food insecurity risk indicator will be presented in the next sub-section, two aspects underlying the choice of the variable should be highlighted: first, the need to incorporate distinct features of the multidimensional nature of food security, such as food utilisation and food stability; second, the availability and reliability of the aggregate data. In order to satisfy these two requirements, the official FAO indicators have been consulted and only complete datasets and raw data have been taken into account. After the creation of the Food Insecurity Risk Index (FIRI), as explained in the methods sub-section, the ordinal outcome variable has been created with three categories measuring the levels of food insecurity risk.

The main explanatory variables of interest include the *rate of urban growth* as well as indicators measuring development, both as binary/categorical variables and by means of specific developmental drivers. The indicator of urbanisation has been drawn from the 2011 United Nations World Urbanization Prospects database. The United Nations World Urbanization Prospects database had been updated several weeks before the analysis was conducted. The level of development has been classified based on UNDP's Human Development Index (HDI). In order to align with the timeframe of other indicators, an average of HDI scores between 1990 and 2000 was calculated and countries reclassified into two and four developmental categories based on the new score. The HDI ranking and indicators have been extensively used and referred to in literature to analyse country-level phenomena pertaining to developmental issues (Kelley, 1991; Anand & Sen, 2000; Neumayer, 2001; Kuhn, 2012; Neumayer, 2012). Individual developmental drivers used in the present study include *mean years of schooling*, *life expectancy at birth*, and *GNI per capita.* Countries' education, which is also an indicator of human capital (Barro, 2002; Becker, 2002; Goujon & Lutz, 2004), will allow testing the second hypothesis regarding the potential mitigating effect of education on the association between urban growth and food insecurity.

In addition to developmental factors, based on the conceptual framework selected confounding variables have been included in the modelling. These comprise the measures of geographical habitat, such as percentage of agricultural land, population stock and aggregate number of disasters at the country-level. Finally, based both on theoretical grounds and empirical evidence, indicators of globalisation have also been incorporated in

Table 3.1 Key variables and data sources.

Variable	Description and Source
Food Security	
Food insecurity risk	Food Insecurity risk based on FIRI. Ordinal variable with three categories: 1 - low risk, 2 - medium risk and 3 - high risk.
Urbanisation	
Urban growth	Average exponential rate of growth of the urban population over a given period. It is calculated as ln(UPt/UP0)/n where n is the length of the period and UP is the urban population. It is expressed as a per cent. United Nations Urbanisation Prospects, 2011 Revision.
Development	
Level of development	Level of development based on HDI values (mean value between 1990 and 2010). Both binary variable (developed vs. developing) and categorical variables are used (very high development, high development, medium development and low development).
Education	Mean years of schooling (of adults). Average number of years of education received by people aged 25 and older, converted from education attainment levels using official durations of each level. Human Development Indicators (HDI), UNDP.
GNI per capita	GNI per capita (constant 2000 US$). Aggregate income of an economy generated by its production and its ownership of factors of production, less the incomes paid for the use of factors of production owned by the rest of the world, converted to international dollars using purchasing power parity (PPP) rates, divided by midyear population. Human Development Indicators (HDI), UNDP.
Life expectancy	Number of years a newborn infant could expect to live if prevailing patterns of age-specific mortality rates at the time of birth stay the same throughout the infant's life. Human Development Indicators (HDI), UNDP.
Population stock	
TFR	Total fertility rate represents the number of children that would be born to a woman if she were to live to the end of her childbearing years and bear children in accordance with current age-specific fertility rates. World Development Indicators, the World Bank.
Globalisation/economic openness	
Trade	Trade (% of GDP). Trade is the sum of exports and imports of goods and services measured as a share of gross domestic product. World Development Indicators, the World Bank.
Foreign direct investment	Foreign direct investment are the net inflows of investment to acquire a lasting management interest (10 per cent or more of voting stock) in an enterprise operating in an economy other than that of the investor. It is the sum of equity capital, reinvestment of earnings, other long-term capital, and short-term capital as shown in the balance of payments. Net inflows (new investment inflows less disinvestment) are reported as percentage of GDP. World Development Indicators, the World Bank.

Table 3.1 Key variables and data sources - continued.

Variable	Description and Source
Internet use	Internet users (per 100 people). Internet users are people with access to the worldwide network. World Development Indicators, the World Bank.
Geographical habitat	
Agricultural land	Agricultural land (sq. km). Agricultural land refers to the share of land area that is arable, under permanent crops, and under permanent pastures. Arable land includes land defined by FAO as land under temporary crops (double-cropped areas are counted once), temporary meadows for mowing or for pasture, land under market or kitchen gardens, and land temporarily fallow. World Development Indicators, the World Bank.
Water productivity	Water productivity, total (constant 2000 US$ GDP per cubic metre of total freshwater withdrawal). Water productivity is calculated as GDP in constant prices divided by annual total water withdrawal. World Development Indicators, the World Bank.
Carbon dioxide emissions	CO2 emissions (metric tons per capita). Carbon dioxide emissions are those stemming from the burning of fossil fuels and the manufacture of cement. They include carbon dioxide produced during consumption of solid, liquid, and gas fuels and gas flaring. World Development Indicators, the World Bank.
Number of disasters	Disaster is defined as a situation or event that overwhelms local capacity, necessitating a request to national or international level for external assistance; an unforeseen and often sudden event that causes great damage, destruction and human suffering. The International Disaster Database (EM-DAT).

Note: The selected data comprises of variables for the following time points: 1990, 1995, 2000, 2005 and 2010. When no data were available for the specific time point, closet available data were used.

the analysis. The indicators of globalisation include those variables that measure the volume of international trade and investments (OECD, 2005, 2010b). Given the increasing importance of "high technology"[15] and information exchange in contemporary societies, access to the internet has also been accounted for.

[15] According to the OECD, when compared to the concept of technology, "high technology" has two distinct features. These are "a) apart from being the most advanced knowledge available, it progresses far more rapidly than other knowledge; b) its degree of complexity requires a vigorous and sustained research effort and a solid technological base" (OECD, 2005, p.167).

3.5.2 The method

This research applies quantitative methods, including descriptive statistics and regression analysis. As highlighted previously, the outcome variable is based on the index of food insecurity risks, which includes indicators of food availability, access, stability and utilisation. This logic follows on from the conceptual framework developed in section 3.2 and subsequent discussion in section 3.3. In order to derive the first outcome variable which measures countries' food insecurity risk, a new index has been created using Principal Component Analysis (PCA). For ease of interpretation, the index has been named the Food Insecurity Risk Index (FIRI). PCA is a commonly used data reduction technique, where information contained in several indicators is retained through key orthogonal linear combinations of these variables. While alternative data reduction methods exist, such as summation of standardised scores, factor analysis and PCA are arguably the most commonly multivariate data reduction methods applied in contemporary social sciences. The advantage of the PCA lies in the fact that principal components can be expressed in terms of observed variables (Harman, 1976) and that its aim is to "optimally account for the maximum amount of variance with the minimum number of components" (de Winter & Dodou, 2014 (in press), p.3). In addition, the results of Keiser-Meyer-Olkin test of sampling adequacy attested that partial correlations amongst variables were high enough for the PCA to be an adequate method of data reduction in our analysis (depending on the time period, KMO was between 0.66 and 0.68). All the variables included in the Principal Component Analysis are official food security indicators developed by FAO.

When choosing specific variables, two main selection criteria have been applied. First, attention has been paid to select only such indicators that do not have many (more than 5 per cent) missing values. Second, indicators that constitute compound indices have been excluded and only "row indicators" taken into consideration. All variables were assigned an equal weighting. The final list of the four variables included in the PCA is presented in Table 3.2, while the descriptive statistics of these variables are shown in Table 3.3. Scree plots showing the fraction of total variance in the data are provided in Appendix D. Given the fact that the dataset has five time points, separate scores were calculated for each time period. The variance explained by the first component ranged from 55 to 57 per cent depending on the time period. Cronbach's alpha was used to assess the score validity as recommended by Bland and Altman (1997, 2002). The values of Cronbach's alpha for

Table 3.2 Indicators used for the construction of the Food Insecurity Risk Index (FIRI).

Indicator	**Definition**	**Food security component**
Per capita Value of Food Production	The total value of Annual Food Production, as estimated by FAO and published by FAOSTAT in International Dollars (I $) divided by the total population. It provides a cross-country comparable measure of the relative economic size of the food production sector in the country.	Availability
Average protein supply	National average protein supply (expressed in grams per caput per day).	Availability/utilisation
Percentage of population with access to sanitation facilities	Access to improved sanitation facilities refers to the percentage of the population with at least adequate access to excreta disposal facilities that can effectively prevent human, animal, and insect contact with excreta. Improved facilities range from simple but protected pit latrines to flush toilets with a sewerage connection. To be effective, facilities must be correctly constructed and properly maintained.	Utilisation
Value of food imports over total merchandise exports	Value of food (excluding fish) imports over total merchandise exports.	Stability

Note: All indicators and their definitions are based on the official FAO indicators of food security. They can be accessed at: http://www.fao.org/economic/ess/ess-fs/fs-data/en/ (date of access: 22/09/2013).

specific times varied between 6.8 (the first time period) and 0.8 (the third time period). The index scores were then grouped into three distinct categories based on the tertile distribution of the data. The three categories are: low, medium and high level of food insecurity risk and thus lend themselves to an ordinal measurement scale. A ranking of countries based on the most recent 2010 score is provided in Appendix E.

While it is common practice to compare the results of a newly created index with related indices, the caveat of this approach is that a similar match is often difficult to find. The International Food Policy Research Institute (IFPRI) regularly computes a global hunger index. However, despite the fact that it is referred to as global, this index is primarily applicable to developing countries. IFPRI's global hunger index is composed of three indicators of malnutrition, i.e. the proportion of undernourished in the population, the prevalence of underweight in children under five and the mortality rate of children under five (Welthungerhilfe et al., 2010). The 2010 hunger index index, which could potentially

Table 3.3 Descriptive statistics of indicators included in FIRI.

Indicator	mean	Standard deviation	median
1990			
Per capita value of food production	271.0	223.1	202.5
Average protein supply	70.4	20.6	67.5
% of population with access to sanitation	64.5	33.0	74.5
Value of food imports over total merchandise exports	48.8	121.2	14.0
1995			
Per capita value of food production	270.2	227.8	202.0
Average protein supply	71.8	20.7	69
% of population with access to sanitation	66	32.3	78
Value of food imports over total merchandise exports	43.7	106.1	13.5
2000			
Per capita value of food production	275.6	238.5	208.5
Average protein supply	73.8	20.7	72.5
% of population with access to sanitation	68.0	31.5	80.5
Value of food imports over total merchandise exports	34.2	73.5	13
2005			
Per capita value of food production	285.5	244.8	224.5
Average protein supply	76.6	20.6	76.5
% of population with access to sanitation	70.2	30.7	82
Value of food imports over total merchandise exports	39.2	104.2	12
2010			
Per capita value of food production	291.2	243.8	239.0
Average protein supply	78.1	20.5	78
% of population with access to sanitation	72.1	30.0	85.5
Value of food imports over total merchandise exports	42.1	97.2	14

be compared with FIRI, was only available for 84 countries and Congo DRC, Burundi, Eritrea, Chad and Ethiopia were found to be most food insecure. These countries are all in the high food insecurity category according to the FIRI, with Eritrea, Comoros and Djibouti topping the list (Appendix E). Recently, a new composite food insecurity index has been developed by the Economist Intelligence Unit for 105 countries[16]. Although also not fully comparable, country rankings reveal similar trends. The modelling choice and model selection are often complex issues requiring analytical decisions based on, amongst others, the type of the data available, model fit, and meeting specific model assumptions. Initially, ordinal logistic models were considered, including the option recently made available by STATA 13 for panel datasets. This possibility, while appealing, is limited to fitting random effects models only, which requires that the idiosyncratic error term be uncorrelated with explanatory variables at any time point. In addition, the basic requirement of the ordinal logistics models is to satisfy the parallel lines, or proportional odds assumption. Because this assumption has not been met, following Williams (2009, 2010), the final choice of the modelling strategy has been directed towards heterogeneous choice models. The main advantage of these models, as compared to the more widely used ordinal logistic models, is that they allow for differences in residual variance. By fitting two simultaneous equations, one for the outcome (choice), and another one for the residual variance determinants, heterogonous choice models increase the validation of cross-group comparisons. As specified by Williams (2010), the basic choice equation for a heterogeneous choice model can be written as follows.

$$y_i^* = \sum_k x_{ik}\beta_k + \epsilon_i$$

In this equation *x's* refer to explanatory variables, which are understood to be "determinants of choice". Each *x* is "a vector of *k* values for *i*th observation". *β's* are the standard regression coefficients and measure how x*'s* influence the outcome (Williams, 2010, p.543-544). Complementarily, the residual variance equation (below) "reflects differences in residual variability that, if left unaccounted for, would cause values to be scaled differently across cases" (Williams, 2010, p.544).

$$\sigma_i = \exp\left(\sum_j z_{ij}\gamma_j\right)$$

[16] The 2013 version of this index can be found at http://foodsecurityindex.eiu.com/Index [last accessed: 19/12/2013].

In this equation, z denotes the vector of j values of for the ith observation, and it can represent grouping variables or continuous variables linked to error variances in the underlying latent variable. Finally, γ is the corresponding regression coefficient demonstrating the effect of z on σ (Williams, 2010, p.544).

In the case of the present research, the three categories of the outcome variable include the food insecurity risks (high, medium and low), while the explanatory variables are almost all continuous. When conducting the analysis, attention has been paid to conduct usual regression diagnostics, including testing for multicollinearity. In order to examine the associations between the explanatory variables, correlation matrices were constructed and inspected. During the modelling, a cluster option was applied in order to control for the presumed lack of independence within groups (countries). In addition, potential time effects have been tested by including dummy variables; however, they proved insignificant. Patterns in data distribution were investigated by specific panel data graphs, such as time-series plots and overall scatterplots. All statistical analyses were conducted using STATA 12 (SE)[17]. The next sections provide an overview of the descriptive statistics as well as the selected regression models, which test the underlying research hypotheses.

3.6 Quantitative analysis

3.6.1 Descriptive statistics

This section presents selected descriptive statistics of the key variables used in the analysis. First, Table 3.4 provides an overview of selected descriptive statistics of the main variables grouped by year. Based on the mean and median values of the variables, it can be deducted that all developmental drivers, including GNI per capita, mean education and life expectancy have been improving, which is in line with the general patterns reported by research (Kenny, 2005; United Nations, 2012; UN, 2013b). At the same time, worryingly, while the prevalence of undernourishment has been declining, indicating that progress has been achieved in the fight against hunger (United Nations, 2012; UN, 2013b), the trends in FIRI show that only a slight improvement has been made in terms of alleviating food

[17] When performing regression analyses, oglm command was used following the research conducted by Williams (2009; 2010).

insecurity risks. This is likely to be caused by the fact that between 2005 and 2010 the average value of food imports over total merchandise exports has been on the rise. Second, underlying associations in panel data can be examined graphically using the overall scatterplot (Cameron & Trivedi, 2010, p.248). When investigating the potential associations between urban growth and food insecurity risk (Figure 3.7), almost a linear pattern between the two variables could be observed. The linear r^2 is 0.31.

Table 3.4 Descriptive statistics of key explanatory variables in the study sample.

Variable	n	Median	Mean	Std. dev.	Min	Max
1990						
Urban growth	174	2.84	2.99	2.18	-1.63	12.13
Mean education	174	6.40	6.10	2.98	0.30	12.30
GNI per capita	173	4,112	8,061	9,274	332	50,400
Life expectancy	174	67.45	64.35	10.19	32.80	79.00
1995						
Urban growth	174	2.41	2.40	2.26	-6.87	9.62
Mean education	174	6.93	6.51	2.98	0.70	12.65
GNI per capita	173	4,421	8,674	10,150	332	49,441
Life expectancy	174	68.65	65.28	10.22	39.25	80.10
2000						
Urban growth	173	2.12	2.16	1.79	-1.85	6.93
Mean education	174	7.45	6.93	3.03	0.90	13.00
GNI per capita	173	4,937	9,297	11,112	237	53,208
Life expectancy	174	70.15	66.24	10.57	39.80	81.20
2005						
Urban growth	174	2.01	2.16	1.80	-2.82	7.39
Mean education	174	7.80	7.30	3.05	1.10	13.20
GNI per capita	174	5,800	10,773	12,761	250	67,920
Life expectancy	174	71.60	67.63	10.41	44.00	82.30
2010						
Urban growth	174	1.88	2.12	1.77	-3.56	12.69
Mean education	174	7.95	7.64	3.00	1.20	13.30
GNI per capita	174	6,866	11,223	11,837	297	48,887
Life expectancy	174	72.75	69.13	9.79	47.40	83.20

Note: Where no value of a specific variable was available for a given year, the closest time point was used.
Data sources: WDI, United Nations Urbanisation Prospects and FAO.

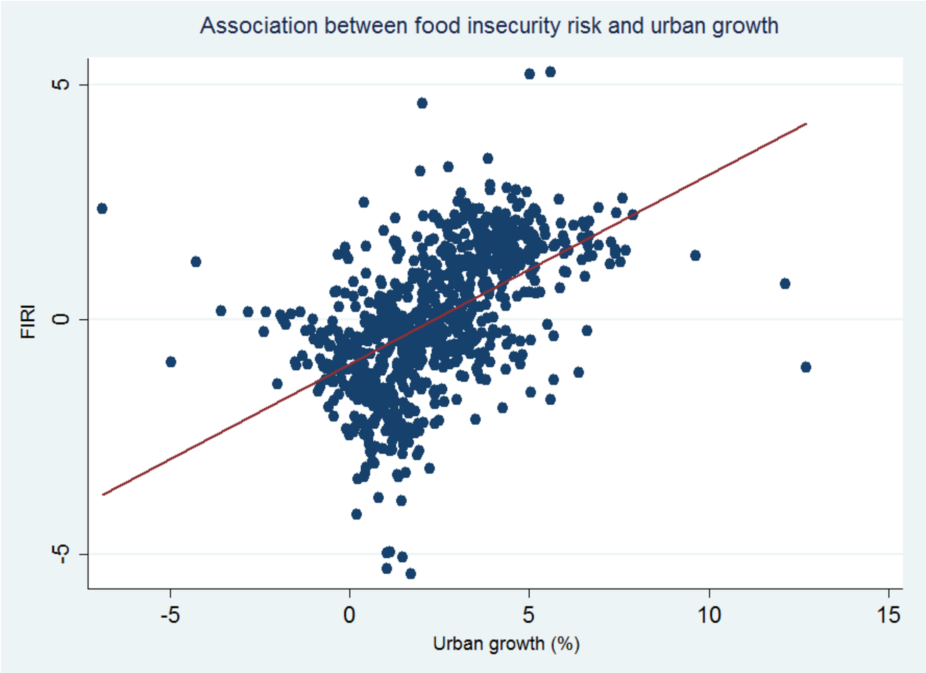

Figure 3.7 Overall scatterplot between urban growth and FIRI.

Notes: Linear R^2=0.31, data source: FAO.

Complementarily, the correlation coefficient between urban growth and the underlying latent variable measuring FIRI based on the complete dataset confirmed a similar pattern (r=0.55, p<0.01). In addition, when testing the correlation between the ordinal food insecurity categories, the results of the nonparametric Spearman's rho confirmed previous results (rho=0.63, p<0.01). The results remain highly significant when only developing countries are considered (rho=0.45, p<0.01), while the correlation is weak for the developed countries (rho=0.15, p<0.05). When the dataset was further disaggregated by time periods, Spearman's correlation rank showed that within developing countries correlation was relatively stronger in more recent years, with Spearman's rho ranging from 0.31 to 0.58 across different time periods (p<0.01). These results are summarised in Table 3.5.

Finally, in order to test for the differences between categories, cross-tabulation of the data was performed and equality of variances tested by means of one-way ANOVA. Table 3.6 summarises the results of this analysis. Overall, it can be noticed that countries that experience greatest food insecurity have relatively higher rates of urban growth. Not

Table 3.5 Spearman's rank correlations between urban growth and food security risk (developing countries only).

Correlations between urban growth and food security risk		
Time	**Spearman's rho**	**p-value**
1990	0.31	0.00
1995	0.41	0.00
2000	0.58	0.00
2005	0.56	0.00
2010	0.52	0.00
Overall	0.45	0.00

surprisingly, most rapid urban growth can be also observed in countries that have the lowest level of human development. Based on the results of the ANOVA test, it can be concluded that there is a statistically significant difference between group means (p-values<0.1). The two-way ANOVA also allows testing the interaction term between the two independent variables. The results of this examination show that the interaction effect between the level of development and the degree of food insecurity risk is statistically significant (p<0.05). These associations will be further investigated by means of regression analysis, where developmental context and individual developmental factors will be incorporated in the modelling. A potential impact of selected confounding factors as proposed in the conceptual framework (section 3.4) will also be accounted for.

Table 3.6 Comparison of mean urban growth by food insecurity risk and countries' level of development.

Dependent variable	**Mean urban growth**	**F-statistic**	**p-value**
Food insecurity risk			
Low	1.20		
Medium	1.94	2.39	0.09
High	3.96		
Level of development			
Low	4.09		
Medium	2.81	13.77	0.00
High	1.21		
Very high	1.15		
*Food insecurity risk*development*		3.03	0.02

3.6.2 Regression results

This section discusses the results of selected regression models. The modelling applied in this chapter follows the standard modelling procedure; first the associations have been tested by means of unadjusted models, while the confounding factors and interaction effects have been gradually added. The results reported in Table 3.7 refer to the high risk of food insecurity. This is the standard routine applied by the *oglm* command, and specific probabilities pertaining to each category of the outcome variable can be estimated and corresponding graphs plotted. For each model, a Brant test (Brant, 1990) has been performed and the variables that were identified to violate the parallel odds assumption have been specifically included in the variance equation[18].

Model 1 tests the first hypothesis, which stated that countries' rapid urbanisation has a negative effect on food security. The unadjusted Model 1 confirms this assumption and specifically demonstrates that a one-unit increase in the rate of urban growth increases the odds of being in the high food insecurity risk category by more than 2.1 times. The model accounts for the potential heteroscedasticity of the explanatory variable (as confirmed by the Brant test) by including the variance of urban growth. When analysing the predicted probabilities of being in the high-risk outcome group (presented in Figure 3.8), it can be noticed that the probability increases from 0.13 for those countries with urban growth rate of 1 per cent to 0.58 for countries with the rate of urban growth of 4 per cent. On the other hand, the probability of being in the category of low food insecurity risk decreases with more rapid urban growth (Figure 3.9). For example, a country with the rate of urban growth of 4 per cent has only 0.1 per cent probability of being in the low-risk food insecurity grouping. The full regression table together with the plotted predicted probabilities for the medium risk category can be found in Appendix F.

Model 2 adds an interaction term of urban growth and development (a binary variable). The interaction is statistically significant ($p<0.01$) and confirms that as urban growth increases so do the odds of being in the high-risk food insecurity category. As can be best observed graphically (Figure 3.10), belonging to the more developed countries group has a strong attenuating effect on the negative impact of urban growth. While less developed

[18] Williams' oglm command allows to specify variables affecting heterogeneity and account for their potential effect by applying "eq2" option (Williams, 2010).

countries with 4 per cent rate of urban growth have 66 per cent probability of being in the high-risk food insecurity group, for more developed countries this probability drops to 17 per cent. This might result from the fact that, as discussed with regard to the typology of urbanisation (section 2.3.3), in developing countries macro-level urban processes are likely to have a more pronounced impact. On the other hand, in the more developed world, urbanisation outcomes rather than processes are presumed to be important influencers of evolving food insecurity threats, such as obesity.

Interestingly, when countries are further divided by low, medium, high and very high level of development, and when clustering and potential heteroscedasticity is accounted for, the association loses its statistical significance (Table F.10, Appendix F). These results might suggest that, while a strong developed-developing countries divide exists in terms of the interactions between urban growth and human development, a more detailed level of development does not influence the effect of urban growth on food security risk. At the same time, however, when disaggregation is considered only amongst developing countries (medium and low development groups) the interaction term is significant ($p<0.05$). *Summa summarum*, this implies that the level of development is particularly important in terms of developing-developed countries divide as well as the division between medium and low developed countries. The division between highly and very highly developed countries is not significant. The relevant regression outputs are provided in Appendix F.

Model 3 incorporates several confounding factors based on the conceptual framework proposed in section 3.4. Thus, in Model 3 the interaction term between urban growth and development has been retained and continues to be highly significant ($p<0.01$). Regarding the impact of globalisation variables, they are statistically significant as confounding factors. On the one hand, there is a positive association between foreign direct investment (FDI) and food insecurity risk (OR=1.05, $p<0.1$). On the other hand, as expected, internet usage is negatively associated with high risk of food insecurity (OR=0.98, $p<0.01$). This effect increases to 0.95 in an unadjusted model. Concerning variables measuring the impact of natural habitat, both water productivity and the proportion of agricultural land have a negative effect on food insecurity, although the latter is not statistically significant. It can be concluded that the interaction effect between development and urban growth is so strong that the impact of other confounding factors in this model is limited. In addition, following on the results of the Brant test (Brant, 1990), the variance effects of agricultural land and

Table 3.7 Regression results.

Food insecurity risk (high)	**Model 1**	**Model 2**	**Model 3**	**Model 4**	**Model 5**
variable	OR (CI)	OR (CI)	OR (CI)	OR (CI)	OR (CI)
Urban growth	2.14 (1.76; 2.61)***	1.84 (1.46; 2.32)***	2.05 (1.55; 2.71)***	2.11 (1.55; 2.87)***	1.33 (1.03; 1.71)**
Development level		0.11 (0.03; 0.33)***	0.17 (0.05; 0.59)***		
Baseline: less developed		1.00	1.00		
Urban growth*development level		0.59 (0.42; 0.82)***	0.54 (0.35; 0.84)***		
Mean education				0.86 (0.71; 1.03)	0.95 (0.86; 1.05)
Urban growth * mean education				0.92 (0.86; 0.95)***	0.97 (0.94; 1.00)**
Life expectancy					0.92 (0.97; 0.98)**
Agricultural land			0.61 (0.29; 1.26)		0.67 (0.50; 0.89)***
Baseline: low proportion			1.00		1.00
Trade					0.998 (0.99; 1.00)
FDI			1.05 (1.00; 1.10)*		1.02 (1.00; 1.04)*
Disasters					1.003 (1.00; 1.01)**
TFR					1.22 (1.05; 1.42)**
Internet usage			0.98 (0.96; 0.99)***		
Water productivity			0.99 (0.99; 1.00)**		0.999 (1.00; 1.00)
Ln(σ)	γ	γ	γ	γ	γ
Urban growth	0.01 (-0.07; 0.09)				
Agricultural land (high proportion)			0.09 (-0.35; 0.52)		-0.08 (-0.44; 0.28)
Mean education				-0.09 (-0.16; -0.02)***	-0.14 (-0.21; -0.06)***
FDI					-0.02 (-0.05; 0.01)
Internet usage			0.00 (-0.01; 0.01)		
Cut point 1	0.72 (0.23; 1.21)***	-1.58 (-2.63; -0.53)***	-1.70 (-2.82; 0.58)***	-1.36 (-3.06; 0.34)	-5.93 (-10.93; -0.93)**
Cut point 2	2.73 (2.12; 3.33)***	1.49 (0.66; 2.31)***	1.50 (0.56; 2.43)***	0.09 (-1.09; 1.27)	-4.48 (-8.69; -0.28)**
Pseudo R^2	0.182	0.348	0.375	0.365	0.574
Log likelihood	-781	-622	-493	-607	-335
n	869	869	719	869	717

Note: * p≤0.1, ** p≤0.05, *** p≤0.01; CI denotes 95% confidence intervals. Cut points are the thresholds of the underlying latent variable (FIRI) used to differentiate between different categories of food insecurity risks.

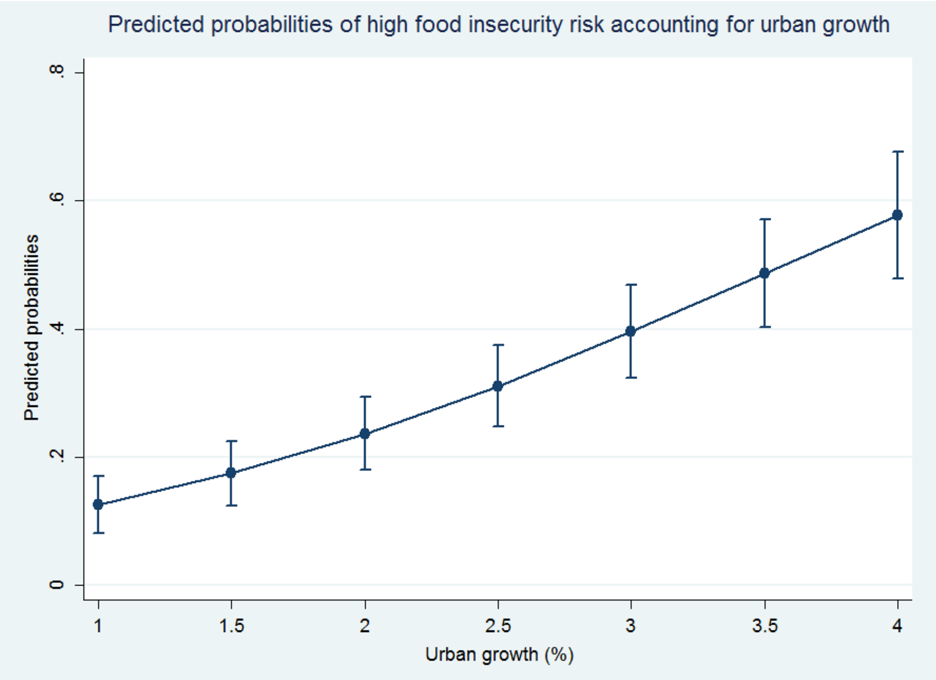

Figure 3.8 Predicted probabilities of high food insecurity risk accounting for urban growth.

Note: Results based on Model 1.

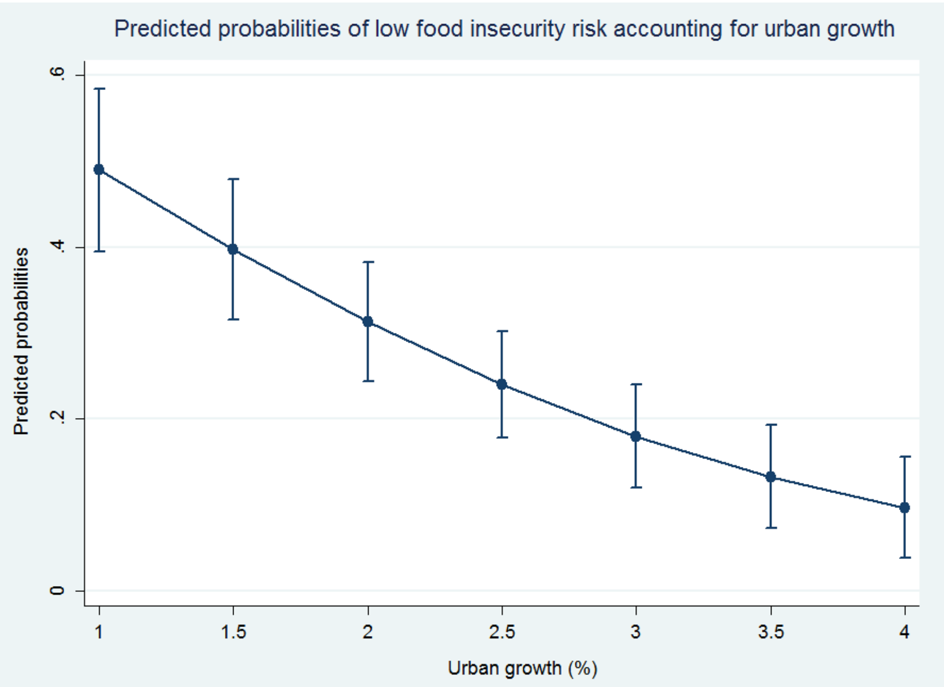

Figure 3.9 Predicted probabilities of low food insecurity risk accounting for urban growth.

Note: Results based on Model 1.

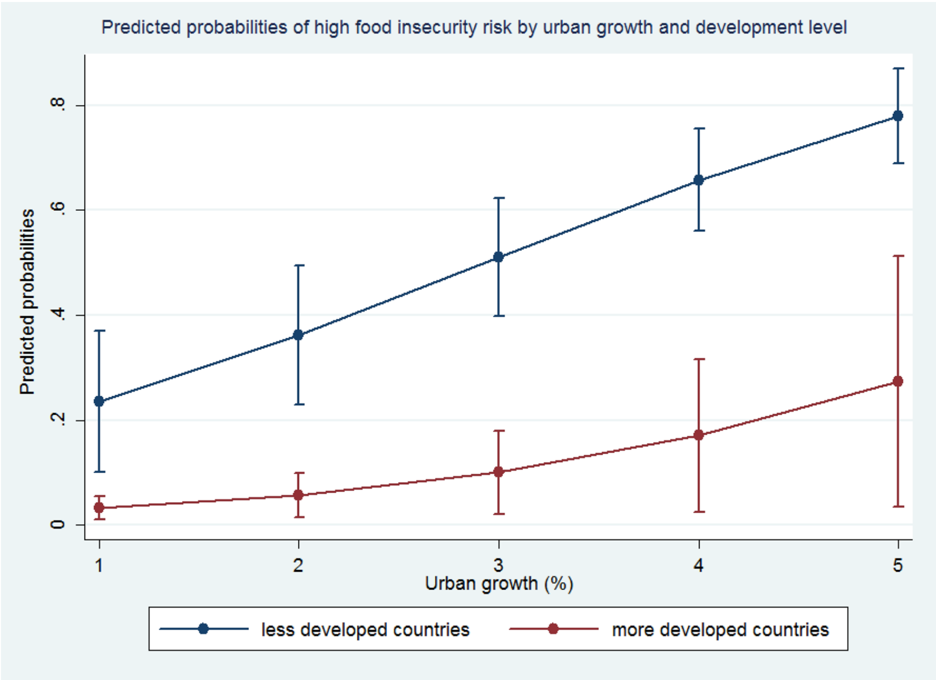

Figure 3.10 Predicted probabilities of high food insecurity risk by urban growth and development level.

Note: Results based on Model 2.

internet usage were accounted for. The signs of both ln(σ) are positive indicating that standard deviation for countries with high proportion of agricultural land is larger and that, as internet usage increases, so do error variances.

The objective of Model 4 has been to test for the effect of the interaction between countries' urban growth and education so as to allow the evaluation of the third hypothesis. As shown in Table 3.7, the interaction between urban growth and education proved statistically significant ($p<0.01$). From a normative point of view, this is hardly a surprising outcome. Education, as an indicator of human capital, has traditionally been perceived as a key factor when it to comes to generation of knowledge, thus facilitating development. Education can not only affect food choices, but also, at the macro level, it can have an important impact in terms of planning, disaster risk reduction and innovation. Model 4 controls for the significant variance effect of countries' education.

Finally, Model 5 includes further evidence of significant impact of the urban growth-education interaction while controlling for selected confounding factors. The effect of the interaction term is presented graphically in Figure 3.11 using the high food insecurity risk category. In particular, the model controls for the impact of life expectancy, an indicator of population health, which is highly significant (OR=0.92, p<.0.1). The negative effect of FDI is confirmed, while the impact of trade becomes significant, although it has become less strong (OR=1.02, p<0.1). As expected, there is a positive association between the total fertility rate and high food insecurity risk, thus confirming the Malthusian concerns. It should be noted, however, that the significance of this variable varies depends on other indicators included in the model. In Model 5, the effect of agricultural land becomes significant. Thus, controlling for other factors included in the model, countries with a high proportion of agricultural land are around 33 per cent less likely to experience high food insecurity risk as compared to countries with a low proportion of agricultural land. Also, the model controls for the impact of disastrous events on the risk of food insecurity. Controlling for other variables in the model, Model 5 shows a very small effect of this indicator (OR=1.003). With regard to the variance equation, it can be noted that the variability in food insecurity risk outcomes declines as the values of mean education and FDI increase. In addition, there was less residual variability in countries with a high proportion of agricultural land (as compared to countries with a low proportion of agricultural land).

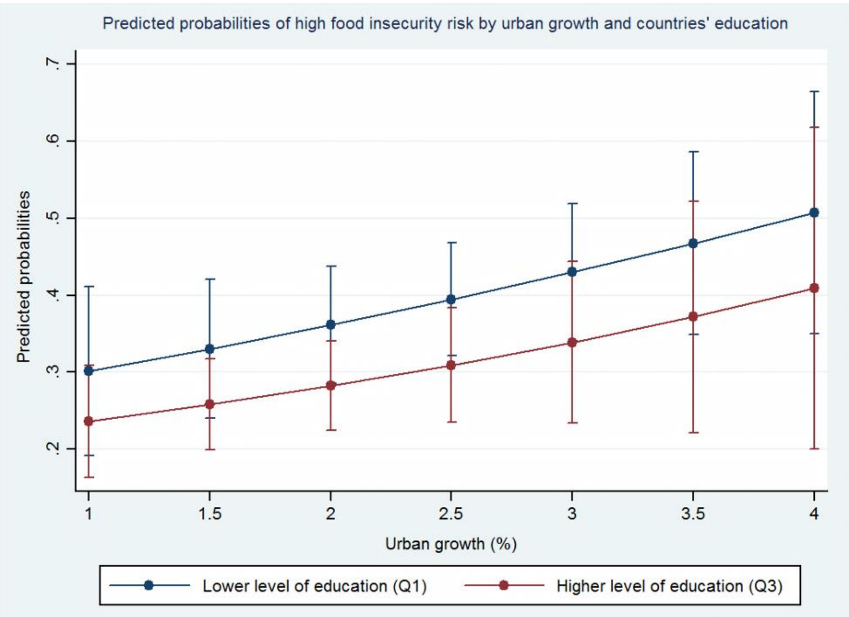

Figure 3.11 Predicted probabilities of high food insecurity risk by urban growth and countries' education.

Note: Results based on Model 5. Q1 refers to 1st quartile, while Q3 refers to 3rd quartile.

Finally, it should be noted that, while GNI per capita and trade have not been included in any of the above-discussed models due to their insignificance or very small effect, unadjusted models were fitted in order to assess the directions of the underlying associations. It was observed that both trade and GNI are negatively associated with high food insecurity risk (ORs=0.99 and 0.999 respectively). The complete regression tables together with predicted probabilities for each category of food insecurity risk are provided in Appendix F. The summary of the results together with the policy implications and the discussion of the limitations of this study are provided in the next section.

3.7 Discussion and conclusions

This chapter had three primary aims. First, the study intended to assess the impact of urbanisation on food insecurity and examine whether and how countries' level of development mitigates this relationship. In terms of its conceptual contribution, the chapter aimed at 1) reorienting the traditional Malthusian debate, turning its focus on urbanisation processes rather than simply population growth; and 2) revising the interpretation of contemporary food security.

Regarding the empirical goal of this study, descriptive statistics and regression analyses were used to test research hypotheses. Based on the results of the quantitative analysis, several conclusions can be drawn. First, macro-level urban growth has a significant positive impact on food insecurity risk. The strength of the association varies depending on countries' level of development. In particular, with regard to the interaction effects between urban growth and human development, a strong developed-developing countries divide has been found as well as a division within the developing countries group (medium vs. low development). Table 3.8 provides a summary of the initial research hypotheses and observed results.

Despite the fact that it is difficult to make direct comparisons with existing results, a vast body of literature exists on the negative impacts of urban growth, including with regard to its effects on water and food security (Ruel & Garrett, 2003; Satterthwaite, 2003; Montgomery, 2004; Neuwirth, 2006; Montgomery, 2008; Matuschke, 2009; Ruel et al., 2010; FAO, 2011; Satterthwaite & Mitlin, 2013). Concerning the confounding factors, previous economic research reported potential negative impact of FDI (Kentor & Boswell,

2003) and natural disasters (IFRCRCS, 2010) on food security. While higher FDI implies that countries are more open to international business, at the same time, as the advocates of dependency theory would argue, it can have a negative effect on economic growth and exacerbate inequalities (Kentor, 2001; Kentor & Boswell, 2003; Lee et al., 2007; Mihalache-O'Keef & Li, 2011). The results of the present study are thus in line with those reported by Kentor (2001), who also found that dependence on foreign capital impedes economic development, while trade openness was positively associated with economic development. Regarding the impact of disastrous events, including natural disasters and conflicts, the results of the present study confirm the findings of previous research which showed that disasters have a highly negative impact on food security (e.g. Webb & Rogers, 2003). Empirically, countries which have experienced natural disasters, such as droughts in the Sahel region, have also suffered from devastating famines and high rates of child undernutrition.

Table 3.8 Summary of research hypotheses and observed outcomes.

Hypothesis	Result	Comment
Countries' rapid urban growth has a negative effect on food security.	H_0 has been rejected	Significant positive association exists between urban growth and high risk of food insecurity.
The effect of urban growth on the food insecurity risk varies depending on countries' level of human development.	H_0 has been rejected	The strength of the association between urban growth and food insecurity varies depending on countries' human development context. In addition, the mitigating effect of the level of development is observed amongst the developing countries, while the same effect is not significant in the developed countries group.
Countries' education has an attenuating impact on the impact of urban growth and the food insecurity risk.	H_0 has been rejected	Macro-level education has a strong mitigating effect on the association between urban growth and food insecurity risk. Countries with the same rate of urban growth but higher level of education are likely to experience lower risk of food insecurity.

The second aim of the chapter was to provide a conceptual contribution in the area of population and development. Here, the first goal was to reorient the Malthusian theory. Starting in section 3.4, this study has provided an initial post-Malthusian framework of the key phenomena which have an impact on the association between urbanisation and food insecurity risks. In addition, the study postulated that, given the current stage of nutritional transition, the interpretation of the food security definition requires a novel approach. The study therefore calls for a more comprehensive set of indicators which would capture the evolving nature of food security. In this context, two recent initiatives deserve credit: firstly, the recently published by SDSN report, which highlights the importance of re-quantifying hunger so as to include "child stunting, food insecurity and malnutrition" (SDSN, 2013, p.28); secondly, the latest Food Insecurity Report (FAO et al., 2013), which discusses multiple dimensions of food insecurity and proposes such new indicators, as percentage of children with anaemia. Future potential indicators should include measures of overweight/obesity, as well as indicators quantifying the quality of food. Multistakeholder cooperation should crucially involve FAO (as a leading agency), but also WHO as a standard setting body in global health, International Fund for Agricultural Development (IFAD), World Food Programme (WFP), the World Bank, and the Global Alliance for Improved Nutrition (GAIN).

While research findings advance the contemporary understanding of the discussed phenomena, certain limitations need to be acknowledged. First, this research does not claim causal relationships, but focuses solely on investigating the underlying associations. Traditionally, research is prone to different types of fallacies, including individualistic and ecological fallacies. In the context of the present study, inferences should not be made beyond the macro-level phenomena. Additional analyses should be carried out, including of Household Income and Expenditure Surveys (HIES), when attempting to disentangle the impact of urbanisation on households' food security. The second limitation is related to the problem of endogeneity. It has been acknowledged that "most non-experimental developmental studies of context are subject to a host of possible endogeneity biases" (Duncan et al., 2004, p.2) . Yet, it is often impossible to conduct natural experiments or quasi-experiments, especially when it comes to cross-country comparisons.

Lastly, it should be stressed that the future outlook in terms of associations between urbanisation and food security is mixed. On the positive side, globally both urban growth rates and fertility rates have been declining over the last decades (Montgomery, 2004; UN, 2010, 2011a;b; Wilson, 2011) and these trends are projected to continue. These increasing global convergence patterns in fertility and urbanisation, but also in economic and human development, provide arguments for an optimistic outlook with regard to sustainable urban development and the fight against hunger and undernutrition. Globalisation, greater openness of countries, increased exchange of information, stronger cooperation and sharing of know-how are all likely to lead to more sustainable urban processes. On the negative side, however, the current trends in the global food industry, urban lifestyle and consumption patterns trigger concern. Importantly, the responses to the food insecurity challenges should be conceptualised and implemented taking into account country-specific and region-specific urbanisation processes and the human development context as well as socio-economic characteristics of targeted populations. As previously highlighted, a cross-national engagement of stakeholders from different sectors is required and should encompass, without being limited to, such policy areas as environment, public health and migration management.

CHAPTER 4 DOES URBANISATION INCREASE HOUSEHOLDS' ACCESS TO SAFE DRINKING WATER? DISENTANGLING THE ROLE OF HUMAN CAPITAL IN A POST-MALTHUSIAN CONTEXT

Abstract – **T**his research investigates household-level and cross-level relationships between urbanisation and access to safe drinking water and examines how households' human capital affects these associations. Previous studies and empirical evidence have shown that education has a mainly positive effect on health outcomes; however, little attention has been paid to the potential impact of education, as an indicator of human capital, on the relationship between different urbanisation and households' access to safe drinking water. The quantitative analysis is carried out using household-level datasets from 19 Demographic and Health Surveys (DHS) supplemented by country-level statistics. The main explanatory variables include: place and type of residence, rate of urban growth and household human capital, which is measured in terms of mean years of schooling of the household members of working ages (18-65). The results of the fixed effects and random intercept logistic regressions show differentiated impact of urbanisation on households' access to safe drinking water. While urban dwellers benefit from greater probability of water access, countries' urban growth has a significant negative effect on households' access to sources of safe drinking water. The study finds that, regardless of which indicators of urbanisation are used, human capital has a significant positive influence on the association between urbanisation and water access. It is suggested that policymakers ought to prioritise not only greater investments in education, but also the establishment of enabling regulatory environments for innovation and knowledge exchange.[19]

Key words: Urbanisation, human capital, human rights, safe drinking water, least developed countries

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[19] The main findings of the previous version of this chapter have been presented during "Population and Environment" session at the XXVII International Union for the Scientific Study of Population (IUSSP) International Population Conference.

> *"The ultimate resource is people – skilled, spirited, and hopeful people who will exert their wills and imaginations for their own benefit, and so, inevitably, for the benefit of us all" (Simon, 1981, p.348).*

> *"Let there be work, bread, water and salt for all" (Mandela, 1994).*

4.1 Introduction

What is the relationship between urbanisation and access to safe drinking water for households in the least developed countries? Does human capital have a moderating effect on this association? Empirical evidence shows that water challenges are particularly relevant in rapidly urbanising countries which suffer from low human development (Kimani-Murage & Ngindu, 2007; United Nations, 2012). While the impact of urbanisation on environment has been investigated on numerous occasions (Bloom et al., 2008; UNHABITAT, 2012; UNICEF, 2012b), as to the best of the author's knowledge, no systematic analysis has thus far been conducted on the impact of urbanisation on access to safe drinking water in the most vulnerable countries. At the same time, although the power of human capital has been widely acknowledged (Durkheim, 1893; Simon, 1981; Boserup, 1993; Jerit et al., 2006; Nelson et al., 2007), limited attention has been paid to the potential mitigating effect of human capital on water access in the context of rapid urbanisation. This study aims to contribute to the existing body of research by examining the above-mentioned questions using quantitative analysis. Recognising that the least developed countries (LDCs) are a distinct category requiring special international attention (UNCTAD, 2011), the analysis in this chapter considers only those households living in countries which have been classified as least developed.

Urbanisation has been a key global phenomenon in the 20th century, and many developing countries continue to experience rapid urban growth, primarily in Asia and Africa. At the same time, the process of urbanisation has had important consequences on the environment, and subsequently human health. For example, a considerable proportion of the urban population in Bangladesh has been exposed to increasing vulnerability, at least partly resulting from uncoordinated urbanisation, inadequate sewage systems and lack of effective waterways (Helal uz Zaman et al., 2010). Lack of access to safe drinking water can lead to waterborne diseases, such as diarrheal diseases, malaria and cholera (WHO, 2012). In addition, it has been shown that cities, which already have difficulties with providing inhabitants with required water resources, are likely to struggle even more due to climate change (McDonald et al., 2011). While empirically the impact of urbanisation on availability of and access to water resources can be observed in different geographical locations, neither academic literature nor practitioner reports seems to be paying attention to the presupposed moderating impact of human capital on urban dynamics and water access. This is despite the fact that previous literature emphasised the strong positive impact of education on health outcomes. Throughout time, different health variables have been used to measure causes of death and health threats, including risk of heart disease, risk of diabetes and possible anxiety or depression. It has been shown that individuals with higher levels of education tend to follow more health-conscious behaviours (Leigh, 1983; Ross & Wu, 1995; Peters et al., 2010). In addition, because of the positive association between education and income, educated people are more likely to reside in urban areas and thus benefit from greater access to healthcare (Leigh, 1983; Ross & Wu, 1995). While it is acknowledged that the associations between health outcomes and education are complex, and instances exist where this relationship may show non-monotonic patterns, like in the case of smoking (Zhu et al., 1997), at the aggregate level the positive association between education and health is unlikely to be contested.

Access to safe drinking water constitutes a *sine qua non* condition for fruitful agriculture, nutritious diet, and ultimately human health. Put simply, together with food, water is the most important vital resource, as simply no life can exist without water. A number of highly developed rapidly urbanising countries, such as Saudi Arabia, the UAE and Qatar, have been able to increase their water supplies through innovative technologies leading to desalination. Similarly, the city-state of Singapore, which experienced significant growth of its urban population, has developed an innovative system of water catchment and purification in order to make best use of abundant rainfalls. These country-level examples provide evidence that knowledge and innovation can have a significant effect on both physical availability and access to safe water. At the micro level, a recent study from rural Ethiopia (Abebaw et al., 2010) confirmed that a significant direct association existed between the educational level of the head of the household and access to improved water sources. While many positive examples of progress can be observed, concurrently entire world regions suffer from limited access to drinking water. In Oceania, 44 per cent of people do not have access to potable water, while in sub-Saharan Africa, 37 per cent suffer from the same problem (UN, 2013b). Many least developed countries face additional challenges, such as lack of political stability or limited expenditure on education, which are likely to have both a direct and indirect effect on peoples' livelihood outcomes. Although the situation has been improving over time, it remains a reason for concern.

In this chapter, water access is measured by well-established UN categories defining "improved" water sources, which include piped water into dwelling, piped water to yard/plot, public tap or standpipe, tube well or borehole, protected dug well, protected spring, and rainwater. All categories are defined in Appendix G. For convenience, the terms "access to safe drinking water", "water access" and "access to improved water sources" are used interchangeably. It is acknowledged that that the categories under "improved water sources" are likely to overestimate the access to actual safe drinking water (Bain et al., 2012); nonetheless the UN indicator provides a useful and widely used proxy for households' access to sources of safe drinking water (United Nations, 2012; WHO, 2012; Yang et al., 2013). Urbanisation is quantified based on indicators of place and type of residence at the household level, as well as urban growth and the percentage of urban population living in slums at the country level. Human capital is measured as mean years of schooling attained by household members of working ages (18-65). Recognising that there has been substantial discussion regarding the definition and measurement of human capital, this issue will be reflected upon later in the chapter (section 4.3.2).

The present study is situated both in the Malthusian debate on population and environment and in the broader contemporary developmental debate. Increased access to water is one of the key developmental objectives, as measured by the Millennium Development Goals indicators (MDG 7). Debates regarding the development of new indicators measuring water stress[20] are taking place in the context of the post-MDG agenda (Hanson, 2013; UN-WATER, 2013; UNESCO-IHP, 2014). Access to safe drinking water is at the core of achieving progress in human development, both in terms of economic prosperity and improved health outcomes. Together with food, the right to water has long been recognised as a substantive human right (Sepúlveda et al., 2004). In 2010, resolution 64/292 adapted by the 64th General Assembly of the United Nations confirmed that access to safe drinking water was a human right (UNESCO, 2012b). Even though at the global level significant progress has been made towards meeting the MDG 7, an alarming number of households

[20] According to the UN (2014), "an area is experiencing water stress when annual water supplies drop below 1,700 m^3 per person".

in developing countries are still deprived of this basic human right. Today, households in urban and rural areas continue to suffer from infectious diseases caused by use of contaminated water or encounter barriers concerning physical access to water sources.

It results from the above that the motivation for this research has been threefold: firstly, the need to advance the knowledge in the area of broadly understood human development and factors contributing to the achievement of global developmental objectives; secondly, the need to highlight the issue of water access as a basic human right and investigate the extent to which this right is exercised; and thirdly, the aspiration to contribute to the traditional Malthusian and neo-Malthusian debate concerning the factors affecting access to key natural resources, such as food and water. In this regard, the proposed study addresses both pro-Malthusian and anti-Malthusian perspectives. This research may be thought of as being pro-Malthusian in a sense that it assumes that a growing population may constitute a challenge to countries. In addition, by selecting water as the response variable, the study's focus is on the basic necessities required for human survival. On the other hand, this research may be thought of as anti-Malthusian because it assumes a powerful role for both human capital and urban processes in terms of affecting the availability of and access to vital resources. The study attempts to answer the research questions by testing the following hypotheses[21]:

H_1: There is a positive association between urban residence and access to safe drinking water in the least developed countries.

H_2: Residents of large cities have better access to safe drinking water compared to rural residents and those in other urban locations.

H_3: In the LDCs, macro-level rate of urban growth has a negative effect of households' water access.

[21] In parallel to the work in this chapter, additional closely related hypotheses have been tested. These included presupposed direct association between human capital and access to safe drinking water as well as presumed mitigating impact of urbanisation on the above association. Both hypotheses have been confirmed. The outputs produced through this work can be provided upon request.

H_4: Human capital has a modifying impact on the association between type of residence and households' access to safe drinking water.

H_5: Human capital has a mitigating effect on the relationship between urban growth and water access.

This chapter is structured as follows. First, a critical discussion of the association between urbanisation and water access is undertaken by referring to relevant literature. This includes accounting for macro- and micro-level interlinkages involved in the analysis of the above relationship. Further background sections include discussion concerning the concept of human capital and recent trends in human capital accumulation, with a particular focus on the least developed countries. Next, a theoretical framework is proposed, drawing from the analytical underpinnings of the capabilities and human rights approaches. In the results section, the findings of the quantitative analysis are discussed, including the outcomes of the multilevel random effects logistic regression. The final section provides conclusions, discussion points, and suggestions for further research.

4.2 Urbanisation and water challenges: selected macro- and micro-level interlinkages

While overall towns and cities have an advantage when it comes to access to safe drinking water, it is important to recognise that impact of urbanisation is likely to vary given the diversity of urban areas and depending on the level of analysis. Although traditional Western patterns of urbanisation have generally been associated with better standards of living, the picture is far more complex when one considers both cross-country differentials and within-country differentials. With a growing number of slums and urban poor the distinction between urban and rural is becoming increasingly challenging. Recently, the United Nations' Department for Social and Economic Affairs (UN DESA) recognised that the traditional rural-urban division, including higher quality of life associated with urban areas, has been blurred (UN DESA, 2012a). Today, within-country urban-rural patterns vary depending on country-specific situations, including the level of development and household-specific socio-economic factors. This line of argument is supported by a methodology developed by the Centre for International Earth Science Information Network (CIESIN), which provides a comparison of rural poverty headcount and urban poverty headcount (CIESIN, 2006). The indices demonstrate that the median for urban poverty is slightly higher as compared to the median for rural poverty, and its spread is much larger. Large urban slums have now become a common feature of many cities, posing additional threats to human health, especially for the vulnerable segments of populations, such as the elderly (Falkingham et al., 2011). Oxfam (2009) warned that Kenya is at risk of a new urban disaster and that rapid urbanisation of the country is changing its patterns of poverty. This phenomenon has implications for households' access to the most basic resources, such as safe drinking water.

More specifically, the interplay between urbanisation and water resources can be analysed from several angles. These include the macro-level dynamics resulting from the speed of urban growth and aggregate water usage, as well as specific advantages and disadvantages pertaining to households' urban residence and access to safe drinking water. When discussing the macro-level dynamics, it is important to highlight the diversified use of water by agriculture, industry and through domestic demand. Naturally, the quality and the quantity of water available for household use is affected by the country's overall demand and water management, including wastewater treatment. Thus, any debate regarding the micro-level dynamics ought to consider contextual factors and the interlinkages between the two. Accounting for the above, the succeeding discussion will be concentrated around three main issues: 1) urban -rural differentials in water demand, 2) health risks resulting from the negative influence of urbanisation on water availability and water quality, and 3) urbanisation and its impact on environmental degradation, including through climate change. Although this chapter does not apply traditional inequality measures, when relevant, disadvantages related to social segregation are highlighted.

Urban growth has usually been associated with greater consumption (Rees & Wackernagel, 1996; Lin & Mele, 2012). This is because at the aggregate level, urban dwellers are likely to have higher disposable incomes and consequently spend and invest more on goods and services. Existing research proved that urbanisation is positively associated with carbon emissions and energy consumption (Liddle, 2014). A case study of urbanisation strategies and land use changes in China found that there was appositive relationship between commodification of land related to urbanisation and fossil fuel consumption (Siciliano, 2012). Cities as a whole can be seen as production-consumption machines where rational consumers function on a basis of trading their work for products and facilities. When discussing the sustainability of cities, Rees and Wackernagel (1996) provided a graphical illustration of a city as a detached entity which takes on resources from surrounding areas, consumes and transforms these resources, and returns them to nature in the form of waste. The question posed by the authors regarding the size of necessary "pasture" to support growing cities continues to be relevant today in the context of increasing water scarcity.

Importantly, the question raises the issue of ongoing rural-urban interdependencies, including the costs and benefits of trading water and the impact it can have on households' subsistence. Traditionally, a key difference in patterns of water consumption in urban and rural areas has been related to agricultural production. Globally, agriculture accounts for around 70 per cent of all water withdrawals (UNESCO, 2012b), and this proportion can increase up to 95 per cent in developing countries (FAO, 2007b). However, in the developing countries resources from agricultural produce are often not sufficient to allow sustainable livelihoods. Because of household dependency on agriculture as a basis for livelihood, sheer poverty and conflicts acting as rural push factors can have dramatic consequences on households' chances of survival. In such circumstances, coping strategies involve migration to the cities, as was the case during the Sahel food crisis (FAO, 2013c). This process stimulates faster urban growth, often without appropriate planning, while at the same time creating greater demand for food and water. Consequently, although in rural areas these households are likely to struggle with water access due to infrastructure, in cities they can face new environmental challenges resulting in lack of continuous supply of high-quality water.

While countryside requires water for crop irrigation and domestic usage, in urban areas industry is a considerable water consumer. This has important consequences also because of how used water is disposed of. In the context of the least developed countries, rapid urban growth can put additional strain on already poor wastewater treatment systems, thus leading not only to environmental pollution but also increasing the risk of disease. In Dhaka, Bangladesh, for example, only 30 per cent of households are covered by sewage systems (ADB, 2007). In addition, as few as 20 per cent of households benefit from the system of solid waste collection (ADB, 2007). In such circumstances, diarrhoea and other waterborne diseases constitute an enduring threat, primarily for the poorest segments of the society. In resource-poor countries, coping strategies of disadvantaged urban dwellers may result in unwitting use of contaminated water leading to health risks. For example, a study of water usage in the Brazilian slum Parque Universitario in Forteleza found that around 30 per cent of samples from water stored in clay pots contained faecal material (Fong, 2013). Similarly, following the outbreak of typhoid in an urban slum in West Bengal, researchers established that *Salmonella typhi* bacteria was carried out through raw sewage, which then contaminated sources of drinking water (Fong, 2013). Thus, while physical proximity to healthcare and other municipal facilities continues to contribute to "urban advantage", crowding, lack of financial access to health services and environmental congestion create new threats. The issue of waste water management in the context of rapid urbanisation is currently the subject of the debate regarding post-MDG indicators (UN-WATER, 2013). UN-WATER (2013) highlighted that the negative impact of poor waste water management affects not only biodiversity, but also human health. In this context, innovation related to reuse development is crucial in order to avoid increasing the current levels of water stress.

Highly urbanised and rapidly urbanising large countries such as the USA, India and China are amongst the leaders in terms of total water withdrawals (World Bank, 2012b) and overall water consumption (GWSP, 2008). Similarly, according to the 2011 data from the US Energy Information Administration (EIA), USA, Russia, China, India and Europe top the list of energy-related carbon dioxide emissions. In the era of global interconnectedness consumption patterns in more developed countries influence resource allocation in other parts of the world. Also, because of the association between urbanisation and consumption and the impact of urban growth on climate change, there is a growing concern regarding future water supplies. McDonald et al. (2011) projected that, in 2050, 993 million urban dwellers are likely to face perennial water shortage, while 3.1 billion urban residents could experience seasonal water shortage. It is anticipated that the greatest water scarcity will take place in Asia and Africa, both in terms of perennial and seasonal lack of water. At the same time, it has been recognised that, amongst the negative consequences of excessive urban water withdrawals, there are important environmental threats posed to wetlands, including imperilled fish species (Smith & Darwall, 2006; McDonald et al., 2011). Rapid urbanisation can disturb hydrological cycles by affecting air circulation, impacting temperatures and frequency of precipitations (Zhou et al., 2004; Jones et al., 2008; O'Driscoll et al., 2010).

In addition, urbanisation is likely to increase the level of environmental pollution, including water and soil pollution. Environmentally contaminated water can lead to further health complications at the household level. In the least developed countries context, unimproved water sources, such as surface water or unprotected wells and springs, continue to be widely used. In these countries, rapid urban growth can further exacerbate the existing challenges related to ensuring universal access to safe drinking water. It is through educated choices and the overall impact of human capital that the negative consequences of urbanisation are likely to be mitigated and the positive externalities of “urban advantage” strengthened, as will be discussed later in this chapter. Prior to that, a short discussion regarding the concept of human capital in the context of post-Malthusian literature imposes itself.

4.3 Human capital

4.3.1 Human capital in the context of the traditional post-Malthusian debate

The debate regarding the pressure of rapidly growing populations on scarce resources, in particular food, was originated by Thomas R. Malthus and his arguments, presented in six editions of the *Essay on the Principle of Population* (Malthus, 1798, 1826). Malthus argued that passion between the sexes, which he assumed to remain constant, generates population growth, which in turn puts a strain on natural resources and leads to poverty. Post-Malthusian researchers criticised this logic as over-simplistic. Scholarly analysis and empirical evidence have shown that it is possible for societies experiencing rapid population growth to enjoy unchanged, or even improved, access to natural resources such as food, water, minerals or energy. Julian Simon (1981) credited human imagination as a key factor enabling such achievements.

Similarly, Ester Boserup (1975) argued that population growth provides incentives for greater investments in agriculture, including through investments in labour. In her revolutionary book *Conditions of Agricultural Growth*, Boserup (1993) claimed that population growth should be considered as independent variable explaining increased food output, rather than the opposite. Through examples of the island of Java and Japan, she illustrated how these rapidly growing populations contributed to higher agricultural productivity and intense land use in both places, ensuring in turn greater availability of vital resources. With a total population of 135 million, Indonesian Java is today the most populous island in the world, while the main island of Japan, Honshu, is the second most populated island.

It comes as little surprise that Japan benefits from a high stock of human capital, given that different educational indicators place Japan as one of the top countries in terms of access to education. Japan scores sixteenth in terms of the mean years of schooling and is in the top quartile when it comes to the expected years of schooling (UNDP, 2011). It has an educational system where 12 years of schooling are compulsory and net enrolment ratio for secondary education is over 98 per cent (OECD, 2010a) as compared to an average of 81.5 per cent for OECD countries. The OECD points out that, since educational surveys have been conducted, Japan has always scored either at the top of the rankings or at near to the top. These achievements result from the commitment of the country to education, including an efficient education management system (OECD, 2010a). While Indonesia, an emerging economy, classified today as a country with medium human development by the UNDP's HDI, does not benefit from a high ranking in terms of formal education, peasants' innovation was at the core of transforming fallow land into highly productive agricultural plots (Boserup, 1993) so as to ensure increased food output. Since 1992, agricultural productivity has slowed down to an annual one per cent growth rate (Bond et al., 2007). Bond et al. (2007) point out that one of the causes of this slowdown was a decline in spending on research and development. At the same time, different cooperation agreements were put in place, notably through Indonesia's membership of ASEAN.

Many more examples could be discussed demonstrating the impact of human capital on improving vital livelihood outcomes. These examples provide evidence that the Malthusian "want of food" does not act as a trigger for positive or negative checks, but rather prompts innovation and thus increases productivity. Scholars who highlighted that new technologies created more problems than they have solved (Diamond, 2005), have been contradicted by arguments that wealth and human capital can continuously improve existing technologies (Goklany, 2007). Goklany (2007) provides an example of what was once an immediate death sentence for those who became infected. Today, thanks to antiretroviral therapies (ART), many suffering from HIV/AIDS continue to live and work. Similar argumentation can be applied to the impact of human capital on availability of and access to basic necessities, such as food and water. It is owing to human capital that transportation networks enabling trade in food and water were created. It is due to human capital that new water catchment areas have been opened in Singapore and new desalination plants established in the arid region of the Middle East.

The author shares the belief that the future outlook in terms of the stock of human capital and its impact on agricultural productivity is positive (Dyson, 1996). Human capital is projected to grow in all world regions. By 2030, China is projected to have the largest number of educated people (Goujon & Lutz, 2004). In sub-Saharan Africa, the percentage of population between 20 and 65 years with secondary or tertiary education is projected to increase from 19 per cent to 35 per cent under one of the three scenarios presented by Goujon and Lutz (2004). While these projections provide an optimistic outlook, also in terms of potentially translating into improved access to vital resources, today, large populations continue to live in sheer poverty with an inadequate amount of drinking water or safe nutrition. Thus, although countries and communities manage to find innovative solutions in order to increase their access to safe water, many rapidly growing nations, such as Burkina Faso, suffer from serious developmental challenges.

Burkina Faso is today a rapidly urbanising, yet predominantly rural country. Taking a neo-Malthusian stance, the World Bank (2009) pointed out that population growth in sub-Saharan Africa constitutes a major obstacle to achieving the Millennium Development Goals. The World Bank's report states that Burkina Faso experienced "a phenomenal" population increase, with "a dramatic" growth in terms of absolute number of live births (World Bank, 2009a). In 1950, the number of live births in Burkina Faso amounted to 200,000, while in 2007 it was reported to approximate 600,000 (World Bank, 2009). The Bank claims that this population growth is likely to threaten the investments in education, food and health (World Bank, 2009, p. 18). At the same time however, it remains a fact that, during the time of its continuing population growth, the residents of Burkina Faso benefited from an increasingly greater access to improved water sources, such as household connections, protected springs or wells, and this figure was reported to rise from 60 per cent in 2000 to 79 per cent in 2010 (World Bank, 2012b). Concurrently, Burkina Faso's score for expected years of education increased from 3.5 in 2000 to 6.3 in 2011 (UNDP, 2011). These trends suggest that, while population growth in Burkina Faso is likely to be a cause of certain societal challenges, it may also provide opportunities. The improvements in the

Box 4.1 Trends in human capital accounting for countries' level of development.

General empirical observation supports the hypothesis that, *ceteris paribus*, people in developing countries are more likely to encounter additional barriers when it comes to meeting their basic needs. Combined with low levels of human capital, these countries are likely to experience unforeseen challenges in ensuring universal access to food and water.

In this context, long-term trends in formal education provide an optimistic outlook. In the last thirty years, there has clearly been an increase in access to education (Figure 4.1). However; it is salient that considerable differences exist between countries based on their level of human development. Thus, countries with lowest levels of human development have suffered from approximately three times lower average years of education, as compared to the highest-developed countries. As of 2011, Norway was the country where residents received longest education, with a score of 12.6 years; whereas Mozambique closed the list with a result of 1.2 years. Although the situation in Mozambique improved from 0.7 years in 1980 to the current score of 1.2 years, most would agree that this result is far from acceptable. Given the benefits of primary education, it has been widely recommended that at least five to six years of schooling should be attained (Bruns et al., 2003). Today, 60 countries report a score of less than six, and 45 countries have a score of five or less (UNDP, 2011). When considering the data for the expected years of schooling, the situation looks similar. Australia, New Zealand, Ireland and Iceland benefit from the highest score of 18 years, whereas Somalia suffers from lowest score of 2.4 years (UNDP, 2011), which is 7.5 times less. At the same time, 92 countries fall below the average of 12.3 years.

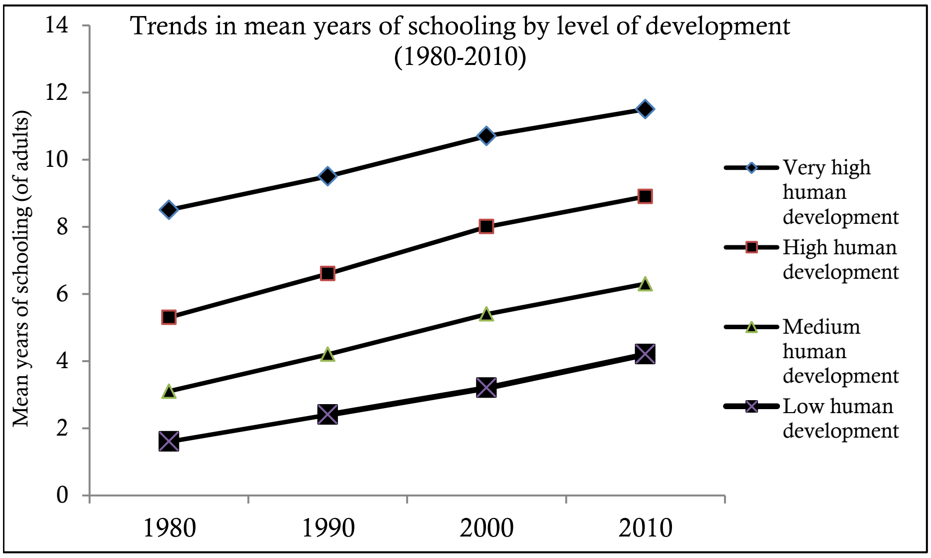

Figure 4.1 Global trends in mean years of schooling by level of development (1980-2010).

Note: Author's own analysis. Levels of development are defined based on HDI ranking. Data source: UNDP.

performance of the key developmental indicators, such as education and water access, provide arguments in favour of the Simonian approach, which this chapter adopts.

Research has shown that in many developing societies which lack formal welfare systems, diversity and adaptability are at the core of survival. In such circumstances, large families (and resulting greater stock of human capital) are treated not as a burden but as an investment. Parents, including foster parents, mitigate their future financial risks by having larger families and hence potentially more extensive social networks in the future. Bledsoe (1995) points out that the Mende community in Sierra Leone places fertility and childbearing at the centre of an adult struggle for power and well-being. In that sense, the number of children, but also their education, can have a positive impact on households' provision of key resources needed for survival. Similarly, rural-urban migration is considered as a strategy to improve life conditions and provide better access to education for children. As discussed previously, urbanisation has created both opportunities and challenges for those who seek to maximise their livelihood outcomes. While many rapidly urbanised countries and communities manage to find innovative solutions in order to increase their water access, others suffer from lack of drinking water access, food insecurity, and sanitation problems. The impact of different urban actors on the human capital-water access relationship will be examined later in the chapter.

Summa summarum, while the neo-Malthusian arguments continue to be predominant in the contemporary literature, evidence suggests that human capital has an important influence on households' ability to maximise their chances of accessing safe food and drinking water. In addition, given the non-negligible impact of human capital on both urbanisation processes and availability of and access to natural resources, it is crucial to test the underlying associations in a systematic, quantitative way. Before this attempt is made, the next sections will focus on discussing the concept of human capital and suggesting a conceptual framework outlying the key presupposed associations.

4.3.2 Conceptualising human capital

This section discusses key issues pertaining to the concept of human capital. For the purpose of this research, human capital is defined as one's capacity to innovate, or generate new ideas, and translate these new ideas into practice. In that sense, it is considered that acquiring human capital equals gaining knowledge. Following on from the existing research (Lutz & Goujon, 2001; Goujon & Lutz, 2004; Lutz et al., 2008), human capital is measured by years of formal education completed. It is, however, acknowledged that some scholars include investments in education, training and medical care as investments in human capital (Becker, 2002, 2008). Similarly, Dyson (1996) as well as Dasgupta and Baschieri (2010) conceptualised human capital as being composed of investments in both health and education.

In addition, with reference to using formal education as an indicator of human capital, several limitations should be acknowledged. First, previous research has recognised the importance of informal education, including pre-school and post-school education, admitting at the same time that the multidimensional nature of education is difficult to quantify (Becker, 2008; Lutz et al., 2008). Second, scholars suggested that a distinction should be made between educational stocks and flows (Lutz et al, 2008). A stock refers to human capital in a sense that it describes people who have already undergone the process of education. Flow, on the other side refers to the process of acquiring education. Third, education attainment neglects the fact that some individuals might have repeated one or more grades. Grade repetition is a particular problem in sub-Saharan Africa, where around 35 per cent the world's repeaters reside. In South and West Asia, the equivalent figure is 28 per cent, while Latin America and the Caribbean is estimated to have 17 per cent of the total number of pupils who have repeated at least one class (UNESCO, 2012a). Although reasons for repeating grades are diverse, they are primarily linked to poverty and institutional framework (Ndaruhutse, 2008; UNESCO, 2012a).

A critical aspect of human capital, as understood in this chapter, involves thinking about the concept as representing peoples' productive capacities. In that sense, human capital can often counterbalance or even surpass the growing global consumption arguably caused by population growth. This has been postulated on many occasions, most notably by Julian Simon (1981) and later by William Gould (2009). Simon argued that the process of knowledge creation and the size of population are associated with both the size of demand and supply. In simple words, the more people there are, the higher the chance of innovative discoveries resulting in increased production. At the same time, the greater the population pressure, the higher the demand for key resources, which in turn creates greater output. Simon claimed that each person contributes to the stock of knowledge and that this overall contribution is so significant that it enables the costs of increased demand for resources to be overcome (Simon, 1981, p. 196).

Importantly, sociological literature highlighted that social actors have a key role in the human capital development (Hechter et al., 1990). The context in which human capital develops is composed of challenges and opportunities within which different social actors, including parents, school teachers and employers, make decisions about investments in human capital. Coleman (1988, p.S118) illustrated that social capital, which is "embodied in relations among persons" plays a key role in formation of human capital in children and youth. Moreover; both the formation and the use of human capital depends on the existence and performance of public and private institutions, at the local, national and international levels. While the present study applies the concept of human capital understood as education it is important to acknowledge that wider socio-ecological factors influence the context in which human capital develops and operates.

The diagram presented in Figure 4.2 is an attempt to disentangle the multidimensionality and knowledge outcomes of human capital understood as education. The starting point – education – is composed of four aspects, i.e. vocational training, formal education, self-study, and on-the-job training. Education triggers innovation, which then results in new technological and non-technological solutions. Some examples of the impact of innovation include those in the area of agricultural production and drinking-water production. This

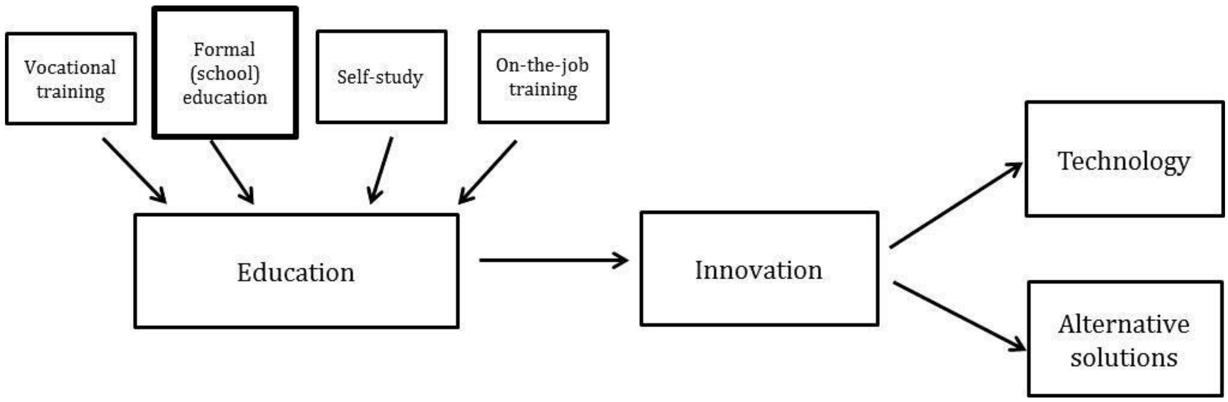

Figure 4.2 Disentangling human capital – a conceptual framework.

impact is not strictly limited to new agricultural technologies or techniques of water purification. Innovations in the sectors of information technology, communications, and transportation are equally crucial because they affect productivity and output when it comes to extracting, processing, and trading natural resources.

While information and communications technology (ICT) has become a key factor when it comes to knowledge sharing, the wide use of ICT should be distinguished from knowledge generation. Although both are interconnected, it is the training required to use modern technology tools which constitute human capital, rather than the use of ICT. No matter how human capital is conceptualised, broad evidence shows that over the past decades human capital has been increasing and that these trends have been positive both when it comes to access to schooling and medical care, and regardless of countries' level of development (Box 4.1).

4.4 Mitigating role of human capital on access to safe drinking water in the context of rapid urbanisation

Empirically, education and access to safe drinking water can be linked in a number of ways. Different water and sanitation programmes have reported that children may be deprived of education because they needed to fetch water. In addition, resource-constrained schools may lack access to improved water sources, which is likely to cause ill health. While these interlinkages have been frequently stressed, little attention has been paid to the mitigating impact of human capital on the association between urbanisation and access to safe drinking water. Yet, the World Water Assessment Program (WWAP) recognised that with better education people are not only able to expend knowledge on best water practices, but also to acquire new skills, which are likely to lead to finding alternative solutions (UNESCO, 2006). For instance, in Kenya examples are known of innovative entrepreneurs who collect rainwater and store it in underground tanks. With greater knowledge and technology, water purification can be applied in increasingly more countries and regions and new water sources are likely to be generated in challenging urban settings.

Based on the discussion regarding the differentiated impact of urbanisation on access to safe drinking water (section 4.2) and given the evidence of the positive influence of human capital, several propositions have been developed for the specific purpose of this study. While human capital can act at individual, community and country level, the focus of this chapter is on the micro level human capital. The suggested propositions concern the presumed mitigating effect of human capital on the relationship between urbanisation and access to safe drinking water and read as follows:

- **Proposition 1**: On average, human capital is higher in urban settings. This represents a double advantage for households seeking to meet their basic needs, such as access to safe drinking water.

- **Proposition 2**: Human capital enables informed choices and innovation, which enhances coping strategies amongst the urban poor, thus preventing capability deprivation.

- **Proposition 3**: Human capital can constitute a buffer to the potentially hampering impact of rapid urban growth and increasing urban poverty.

Overall, the first proposition refers to the positive impact of urbanisation, while the second and third prepositions presuppose the potentially negative effects of urbanisation. As far as the first proposition is concerned, it has been widely acknowledged that on average urban residents tend to have better access to safe drinking water, education and healthcare (Cohen, 2006; United Nations, 2011a; UNICEF, 2012b). In general, cities provide better infrastructure and educational facilities, which in turn is likely to result in greater employment prospects. Schools, including universities, tend to be located in urban centres and students often change their place of residence to urban areas in order to follow educational opportunities. At the primary and secondary level, urban children are more likely not only to enrol in schools, but also to complete secondary education and better balance work-school demands (UNICEF, 2012, p. 14). This phenomenon has often been referred to as "urban advantage" (UNICEF, 2012, p. 6). Given the importance of infrastructure and its association with urban and peri-urban locations, as well as the fact that better infrastructure positively affects educational attainment, access to water and health facilities, it is sensible to deduct that human capital has an amplifying effect on the right to water exercised by urban households.

Secondly, the accumulation of human capital is likely to lead to generation of knowledge, although certain time lag is likely to occur between the flow and stock of education and innovation. Naturally, in cases where an increased proportion of urban dwellers reflects higher number of slums, the extent of added value of human capital could be challenged. Currently, with 62 per cent of urban residents living in slum areas, sub-Saharan Africa suffers from the highest slum prevalence, whereas in Asia average slum prevalence varies from 35 per cent in South Asia to 25 per cent in Western Asia (UNHABITAT, 2012). While in certain cities, like Havana, residents of substandard accommodations benefit from the same access to education, in most other cities, including Quito and Nairobi, access to education by children living in slums remains a challenge. Households suffering from one or more shelter deprivations[22] can be at a disadvantage when it comes to their capacity to access safe water. Yet, even though in slums human capital is often poorly developed, empirical evidence suggests that considerable improvements in water access have been taking place in deprived urban localities. In this context, human capital can prevent capability deprivation (Sen, 1999), while increasing the chances of functionings related to and resulting from water access.

Examples of the impact of human capital in poor urban settings include the use of sun-powered water ATMs in slums in India and *awami* (people's) water tanks in peri-urban areas in Pakistan. India's innovative ICT-tracked water ATM system has been recognised for its pioneering contribution to the society, also through an award by the Tech Museum of Innovation. While initially the project targeted primarily rural areas, it has now expended to urban locations, including Delhi slums, where marginalised communities are able to access clean water in a convenient and inexpensive way. Similarly, community water tank developments in Orangi township, near Karachi, provide evidence of the power of innovation and local engagement which resulted in considerable improvements in water access for the urban poor. The Orangi township in Pakistan has been long known for its informal settlements, so-called *katchi abadi* (Ahmed & Sohail, 2003), which for a number of reasons[23] struggled to attain an adequate water supply. However, by mobilising political and religious leaders, the residents of Orangi were able to build underground water tanks to

[22] By definition, shelter deprivations include access to improved water sources. Here, when speaking about shelter deprivations, the focus is on household conditions, such as housing material and potential overcrowding.

[23] Main reasons included rapid urban growth and poor rainfall (Ahmed & Sohail, 2003).

store and distribute water. In some cases, these water tanks have been constructed through people's self-help (Ahmed & Sohail, 2003; Satterthwaite, 2003). While further instances of the impact of human capital and innovation in challenging urban settings could be provided, it is also important to highlight the cross-level interactions between urbanisation, water access and human capital.

In addition, human capital can play a role in preventing the potentially negative influence of rapid urbanisation taking place in developing countries. As highlighted in section 4.2, uncontrolled urban growth can have a disruptive effect on the environment, including agriculture. Moreover, rapid urbanisation can put a strain on governments' capacity to plan for delivery of basic services. Research conducted by Chinese scholars (Chen & Yang, 2010) showed that a rapid increase in the numbers of migrant children caused by growing rural to urban migration could result in children being left out of formal schooling system. On the other hand, when urban growth is planned and managed by both central and local authorities, urbanisation is likely to benefit communities by providing them with greater access to educational and health facilities.

In this respect Cambodia's Phnom Penh constitutes a relevant good governance example (Roberts & Kanaley, 2006; Biswas & Tortajada, 2010). As a city, Phnom Pen has experienced unusual urbanisation patterns resulting from the country's complex recent history. Following the seize of power by the Khmer Rouge and its ambition to create a classless society, which involved forced relocation of urban residents, the population of Phnom Penh saw a dramatic decrease (Biswas & Tortajada, 2010; Brunn et al., 2012). After the fall of the Khmer Rouge, the trend was reversed with a rapid growth of the city. While in 1993 the population of Phnom Pen counted 700,000 inhabitants, it had reached over 1.3 million in 2008 (Biswas & Tortajada, 2010). Although initially inefficient when dealing with the growing city's demand for water, the Phnom Penh Water Supply Authority (PPWSA) gained substantial autonomy and through innovation and good governance practices was able not only to increase the overall amount of water supplied, but also reduce the proportion of unaccounted for water (UFW)[24]. It is not insensible to

[24] The World Bank defines UFW as "the difference between the quantity of water supplied to a city's network and the metered quantity of water used by the customers. UFW has two components: (a) physical losses due to leakage from pipes, and (b) administrative losses due to illegal connections and under registration of water meters" (World Bank, 2013).

deduct, based on the above, that an appropriate channelling of human capital supported by financial incentives can lead to powerful solutions, such as increasing overall water availability and expanding the distribution of clean water.

Following on from these propositions a new conceptual framework is suggested drawing from existing theoretical underpinnings.

4.5 Conceptual framework

The conceptual framework in this chapter has been motivated by Amartya Sen's capabilities approach as well as by the human rights framework borrowed from developmental studies. With regard to the former, throughout his extensive analysis of macro-level events (e.g. famines) as well as individual behaviour and motives, Sen developed an alternative approach to the traditional classical economics view of development. Drawing from theories of past thinkers, including Adam Smith, Sen proposed a set of novel interconnected concepts aiming to explain human well-being or lack thereof. The key concepts consist of the following: 1) capabilities, 2) commodities or commodity bundles, 3) entitlements, and 4) functionings. Distinguishing from approaches focused solely on the importance of financial resources, Sen highlighted that a person has less capability, if she has "less real opportunity to achieve those things that she has the reason to value" (Sen, 2010, p.231). As pointed out by Clark (2005), capabilities imply that an individual has the possibility to choose their preferred options. Thus, for example, a person can have access to nutritious food and safe drinking water but can refuse consumption of it because of a strike or for religious reasons. Martha Nussbaum (2000) stressed that Sen's concept of capabilities was directly linked to a space in which comparisons of quality of life could be made. Furthermore, the concept of capabilities is strongly linked to the freedoms that people have (e.g. political freedoms) in order to be able to realise their goals.

At the same time, however, Sen recognised that commodities, or commodity bundles, constitute a basis for exchange also in the context of individual entitlements. Commodities are important because they represent the desired characteristics from which the person can benefit. Naturally, a person can decide to use only a limited amount of water; however, the possession of a water source allows her to increase the entitlements base. As highlighted in

Chapter 3, entitlements involve "the set of alternative commodity bundles that a person can command in a society using the totality of rights and opportunities that he or she faces" (Sen, 1997b, p.497). This is particularly relevant in a context where water resources, and notably safe drinking water, are becoming increasingly scarce. Finally, functionings refer to the achievements of a person, or "what he or she manages to do or to be" (Sen, 1999, p.10). Functionings result from the ownership of commodities as well as individuals' capabilities. Thus, for example, water is not only a resource or a commodity *per se*, but it constitutes a basis for food preparation, irrigation of agriculture, gardening, or even leisure. What a person manages to do with a source of drinking water contributes to her functionings.

The capabilities approach developed by Sen is intrinsically linked to the contemporary human rights framework. Human rights are defined as "inalienable fundamental rights to which a person is inherently entitled simply because she or he is a human being"(Sepúlveda et al., 2004, p.3). Within human rights one can distinguish fundamental rights, which involve the right to life and inviolability, and substantive rights, such as the right to an adequate standard of living. The latter includes the right to food, water, shelter and clothing. Similarly to the concept of food security, the right to water is composed of three key elements, i.e. availability (including continuity of access), quality and accessibility. Accessibility can be physical, economic or informational, implying that individuals are entitled to receiving information concerning water issues (Sepúlveda et al., 2004, p. 274). In the context of the present research, it is noteworthy that all the above-mentioned aspects of water-related human rights can be influenced by urban processes and households' place of residence.

Analysing both concepts (i.e. capabilities and human rights), Sen highlighted that a parallel existed between his capability approach and the human rights framework, although they were not the same. The key difference lay in the fact that capabilities focused on opportunities that individuals had to achieve their desired functionings, while human rights encompassed both opportunities and processes. In addition, as argued by Sen, it would have been problematic to create a comprehensive list of capabilities, as this could negate a "possibility of progress in societal understanding" (Sen, 2005, p.160). On the other hand, Nussbaum (1997, p.293) claimed that maximising individuals' capabilities should be the goal of public planning, and as such rights needed to be understood as capabilities. According to Nussbaum, a right can be conceived as a theoretical or idealistic ability of a person to fulfil their basic physical and emotional needs, as well as the provisions made for this right to be met. Contrarily to Sen, Nussbaum listed a set of ten capabilities, which overlapped with some of the contemporary human rights, such as freedom of speech, right to education and property.

Drawing from the approaches discussed above, the suggested conceptual framework (Figure 4.3) represents key relationships between urbanisation, human capital, and access to safe drinking water as a critical determinant of human survival. It is argued that both macro-level urban processes and place of residence constitute important elements of the capabilities environment influencing access to vital resources (e.g. water). Similarly, the level of initial human development in the country is a fundamental part of the capabilities environment. Naturally, it could be argued that many other factors influence human capabilities; yet it should be remembered that the focus of this framework is on the primary

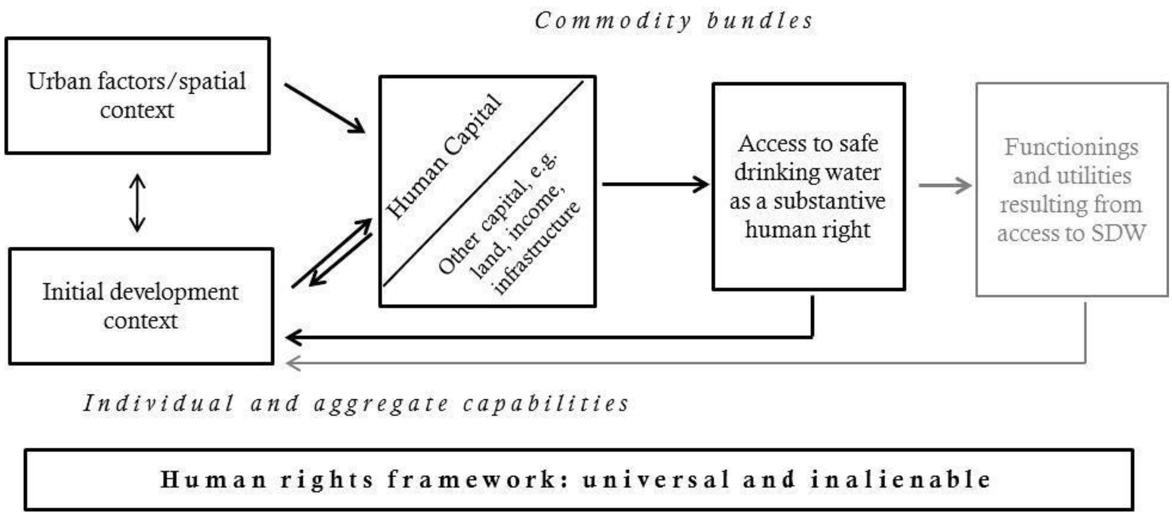

Figure 4.3 Conceptual framework.

research questions. Human capital can be perceived as both an important capability influencer and a key commodity which creates opportunities for exchange entitlements. In his discussion of differences between human capital and human capabilities, Sen (1997a) highlighted that human capital should be understood in terms of human agency to increase individuals' productive capacity, while human capability is the ability to achieve the desired outcomes.

Finally, the direct and indirect input factors impact households' access to safe drinking water and subsequently individuals' functionings resulting from this access. Thus, being able to exercise the basic human right to water can allow people to "be" and "do", i.e. to satisfy thirst and to prepare food. As in other feedback loops, both having access to SDW as a commodity and utilising it in a form of functionings contribute back to a higher level of human development in the country. In addition, while this framework focuses on right to water as the human right of interest, it should be highlighted that the process is embedded in a broader human rights framework.

4.6 Dataset and method

4.6.1 Data sources and key variables

Two separate sets of data have been used for this analysis. The first one is a relatively small dataset of country-level data including three key variables: countries' access to improved water sources (percentage with access), education (mean years of schooling), and rate of urban growth. The overall *n* for this dataset is 172 countries and statistics are drawn from the World Development Indicators, UNDP's development indicators and UN Urbanisation Prospects. This dataset was used in order to allow a snapshot analysis of country-level data, thus providing a background for the main analysis. The second and primary dataset for this study consists of the combined data from 19 Demographic and Health Surveys (DHS) supplemented by country-level statistics. Selected DHS datasets include only waves five & six of standard DHS surveys conducted between 2000 and 2010. Out of the 19 LDCs, 15 countries are geographically located in Africa, and the remaining four are in Asia. The complete list of countries, including the number of observations by country as well as their respective dates of joining the LDCs category, is provided in Appendix H.

The pooled DHS dataset consists of 201,784 household-level observations. It should be acknowledged as a limitation that not all variables are available at the level of each individual survey, which restricts the number of potential confounding factors. For example, variables quantifying ownership of agricultural land or defining which household member collects water are not available across all datasets. Indicators of access to safe drinking water are used as outcome variables, whereas place of residence (urban, rural), type of residence (large cities, small cities, towns, countryside), mean years of education of household members in working ages, and countries' rate of urban growth are the main predictor variables. The term "place of residence" is used to refer to urban vs. rural residence, while "type of residence" denotes desegregated localities, including large cities, small cities, towns and countryside. As mentioned in Chapter 2, following the DHS classification, capitals and large cities are those with more than one million inhabitants, small cities have between 50,000 and one million inhabitants, and towns are other urban areas.

The outcome variable is based on the official list of the Millennium Development Indicators[25]. The categorical response variable measuring access to improved water sources, was recoded and grouped into two main categories – "safe" and "unsafe" – as per the recommendation of the WHO/UNICEF Joint Monitoring Programme (JMP) for Water Supply and Sanitation. Overall, around 69 per cent of the households in the sample have access to safe drinking water. The distribution of this variable by country is presented in Figure 4.4. It can be noticed that, in general, households in least developed countries suffer from considerable water deprivation. It is also salient that countries experiencing rapid urban growth show greater lack of safe water. Some countries, like Bangladesh, appear to be less affected by lack of access to safe drinking water. To a certain extent, this can, however, be misleading, given the fact that an overwhelming majority of the population uses public water sources. The quality of public water, although classified as improved, may often not fulfil the necessary safety requirements, which points to the limitation of the UN categories. Figure 4.5 provides a disaggregated representation of the categorical variable measuring access to safe drinking water. Here, the households who have access to improved water sources were further split into those who have private access to safe drinking water (e.g. piped access in the dwelling or in the yard) and those who collect water from public sources.

As already pointed out, mean education of household members of working ages (18-65) is used as the main explanatory variable. Level 1 control variables include widely used socio-demographic and economic statistics, such as age and gender of the head of household,

[25] The official list of the Millennium Development Indicators can be found at http://mdgs.un.org/unsd/mdg/Host.aspx?Content=indicators/officiallist.htm (last accessed: 25/12/2013)

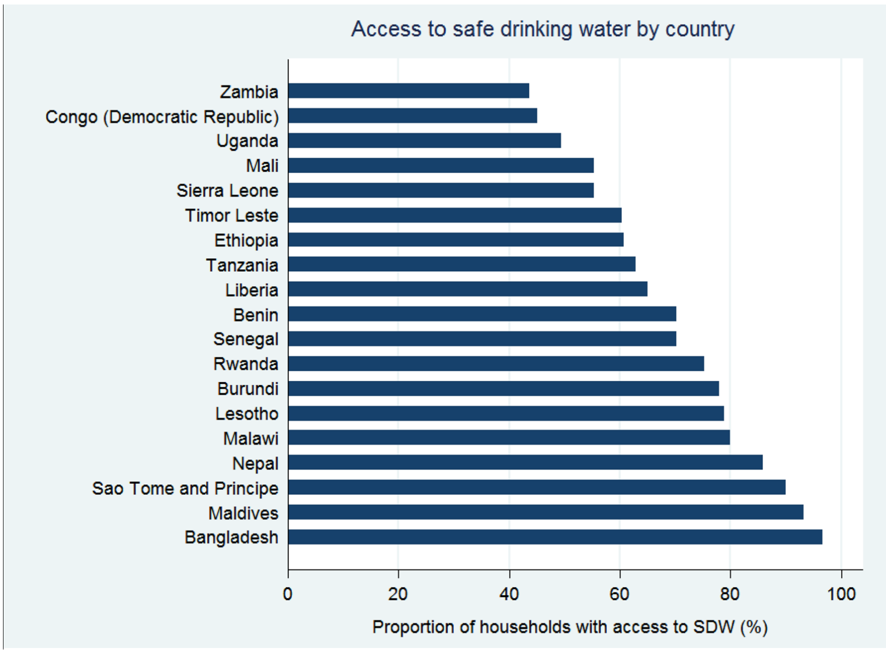

Figure 4.4 Household access to safe drinking water.

Note: Author's calculations based on DHS data.

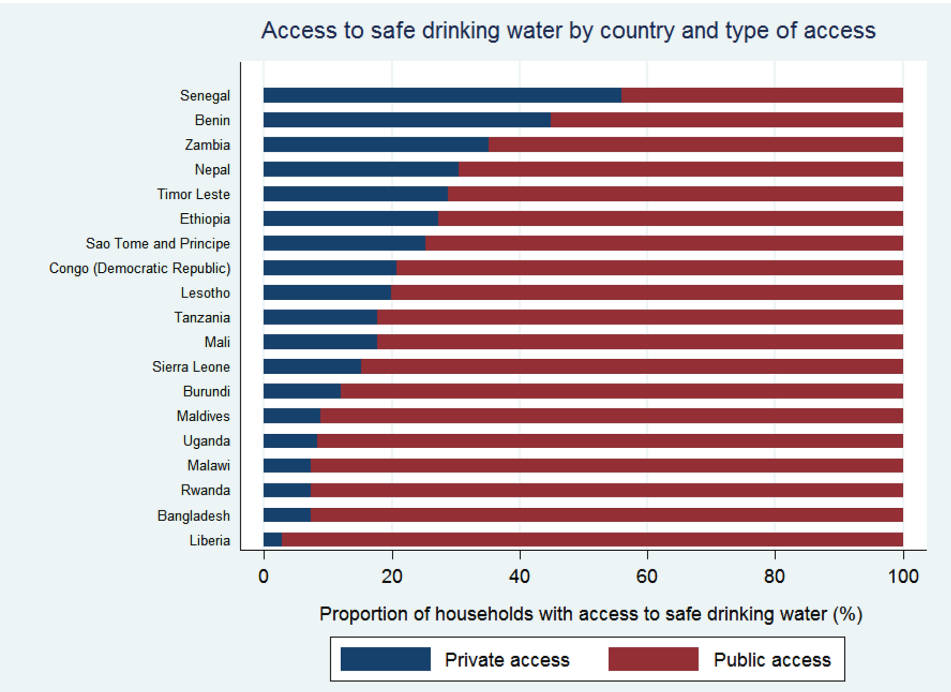

Figure 4.5 Household access to safe drinking water sources (private vs. public water sources).

Note: Author's calculations based on DHS data.

place of residence, type of residence and household size. Most variables are categorical and have been recoded for ease of interpretation. For example time to collect water has been recoded into three main groups (less than 10 minutes, between 10 and 30 minutes, and more than 30 minutes). The distribution of key micro-level predictor variables (place of residence and household education) are presented in Figures 4.6 and 4.7. Level 2 contextual variables constitute country-level data, and include statistics related to urbanisation (proportion of urban dwellers in slums, rate of urban growth), data measuring infrastructure and transportation, political stability, governments' expenditure on education and countries' GNI per capita. Contextual data are based on the World Bank's World Development Indicators (WDI), the World Bank's Worldwide Governance Indicators (WGI), and United Nations World Urbanisation Prospects (2012). Table 4.1 provides a list of key variables used for the analysis together with the main summary statistics.

Table 4.1 List of response and key explanatory variables.

Variable	Variable type	n	Data source
LEVEL 1: HOUSEHOLD			
Access to an improved water source	binary	200,507	DHS
Education of HH members in working ages	continuous	194,657	DHS
Number of household members	categorical	201,784	DHS
Type of place of residence	categorical	96,874	DHS
Place of residence	binary	201,784	DHS
House wall material	categorical	199,849	DHS
Sex of the head of HH	binary	201,784	DHS
Time to fetch water	categorical	201,784	DHS
LEVEL 2: COUNTRY			
Urban population in slums (%)	continuous	19	United Nations
Rate of urban growth (%)[26]	continuous	19	United Nations
Political stability (index score)	continuous	19	World Bank
Paved roads (%)	continuous	19	World Bank
Expenditure on education (%)	continuous	19	World Bank
Population change (%)	continuous	19	United Nations
GNI per capita (US$, Atlas method)	continuous	19	World Bank

[26] The rate of urban growth (2000-2005) is defined as "Average exponential rate of growth of the urban population over a given period. It is calculated as ln(UPt/UP0)/n where n is the length of the period and UP is the urban population. It is expressed as a per cent." (UN, 2011b)

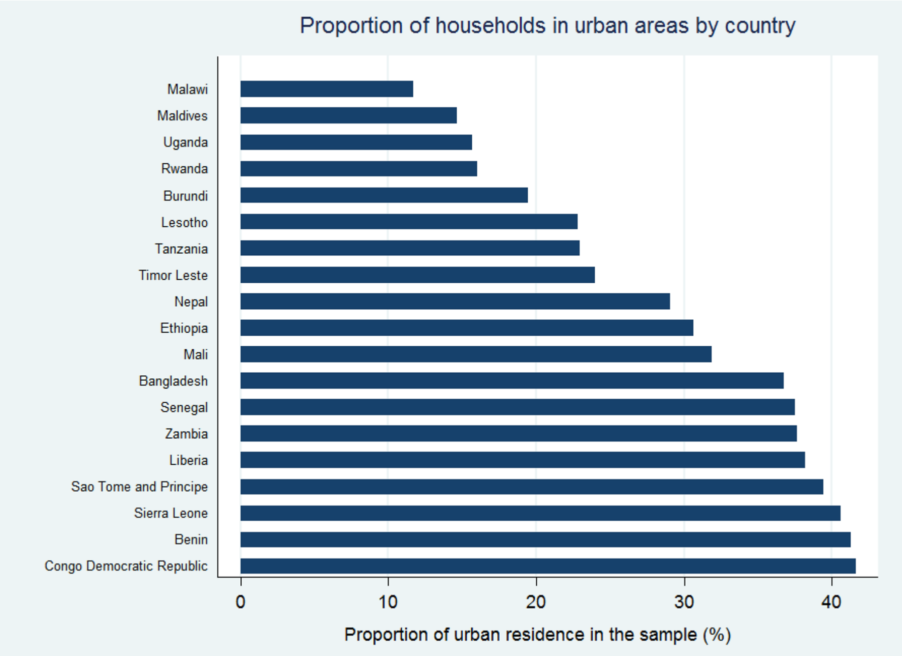

Figure 4.6 Proportion of households with urban residence by country.

Note: Author's calculations based on DHS data.

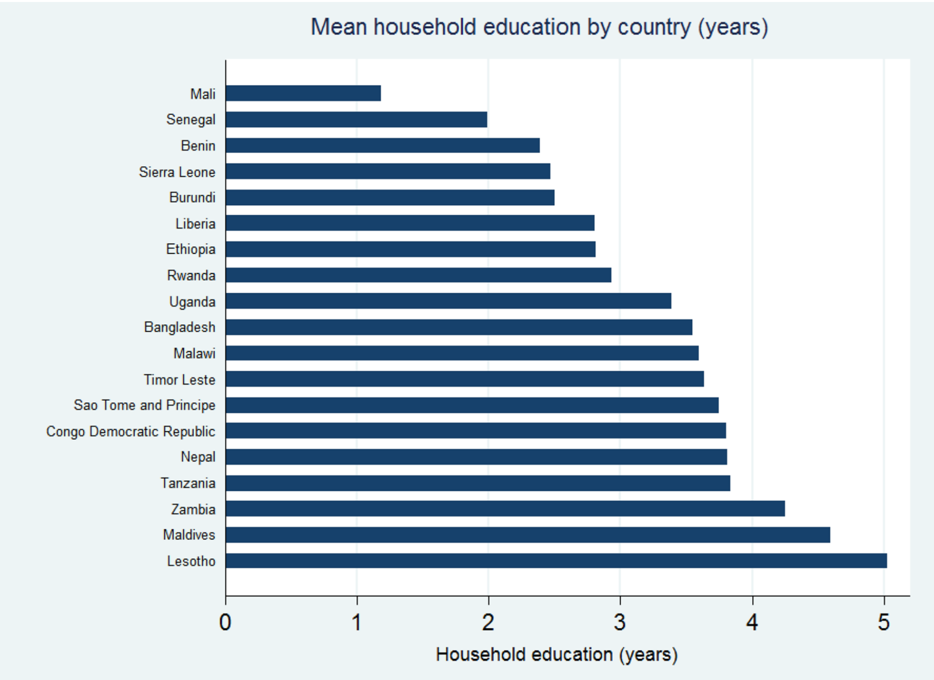

Figure 4.7 Household education by country.

Note: Author's calculations based on DHS data.

4.6.2 The method

In addition to descriptive statistics, this study makes use of linear and multilevel logistic regression modelling. In the first dataset with country-level statistics all three variables are continuous and therefore linear and multiple linear regressions are applied. On the other hand, logistic regression is used as the standard quantitative technique to test associations between variables when the dependent variable is dichotomous (which is the case in the main dataset). Building on fixed effects logistic regression, multilevel logistic modelling allows us to account for hierarchical data structure. Multilevel modelling is therefore widely used when examining hierarchical or nested datasets, in which higher levels of analysis include such structural elements as households, classrooms, regions or countries.

Multilevel modelling

The term "multilevel" refers to data which have a hierarchical or nested structure, such as data pertaining to individuals within organisational entities (Hox, 1995). Multilevel analysis can also be used when repeated measures are taken for the same individuals within clusters. It is reported to have originated in educational research, when researchers realised that the results for students clustered within the same classrooms or even neighbourhoods were not statistically independent (Twisk, 2006). Correlation within the same clusters, or intra-class correlation, was found to be higher than correlation between clusters. Because of the differences in intra-cluster and inter-cluster correlations, application of standard regression tools is likely to lead to spurious or biased results.

The unique advantage of multilevel analysis is that it enables researchers to test hypotheses pertaining to micro-macro-level propositions. In doing so, multilevel analysis allows us to avoid both ecologic and atomistic fallacies. Snijders and Bosker (2011) distinguished between three specific cases of associations. First, when there is a direct association between macro-level data and micro-level data, such as country's infrastructure and household's access to water. Second, when there is an association between micro-level and macro-level data, the effect of another micro-level variable is also taken into account. This might involve, for example, a modifying effect of human capital on the association under investigation. Finally, the third case occurs when the relationship between two micro-level variables is dependent on a contextual variable. In the present study, all three cases are of interest. Relationships are assumed to exist on a micro-micro as well as micro-macro scale, and they are thought to be influenced by both household-level and contextual factors. For example, variables measuring urbanisation and infrastructure are hypothesised to have a direct effect on households' access to safe drinking water. Logically, in countries that benefit from better road networks there is likely to be a higher probability of access to safe drinking water.

When it comes to the technical aspect of multilevel analysis, the main difference between standard regression modelling and expanded multilevel regression is the fact that the latter combines different levels of analysis by allowing both the intercepts and slope coefficients to vary. Mathematically, the basic equation for multilevel modelling can be subscribed as follows:

$$Y_{ij}=\beta_{0j} + \beta_{1j}X_{1ij} + \beta_{2j}X_{2ij} + e_{ij}.$$

where subscript $_i$ refers to level one variable, subscript $_j$ denotes level two variable, β *is* the estimated regression coefficient and e_{ij} is the residual term (Hox, 1995). In this chapter, level one data refer to household-level variables, while level two data denote contextual country-level indicators. In order to perform statistical analysis STATA package (version SE12) is used. Relevant STATA functions, including its recently added *-xtmelogit-* command, are routinely applied to examine, recode and analyse the data.

The multilevel model selection was carried out based on the commonly applied criteria, balancing theoretical deliberations and statistical model fit. Model fit was assessed by widely used statistical tests, such as Wald test and log likelihood test. Estimated predicted odds are the odds of accessing an improved water source. As in the fixed effects logistic model, they have been calculated to facilitate the interpretation of results following the statistical procedure suggested by Buis (2010). Buis (2010) pointed out that, although odds have a reputation for being difficult when it comes to interpretation, in the case of the present study they simply indicate the expected number of households that have access to SDW as compared to those that do not.[27] It is important to highlight that, in the presence of interaction terms, individual coefficients (main effects) which are part of interactions

[27] The results are presented graphically using the marginsplot command, a powerful new addition to Stata 12, which allows effective visualisation of interaction terms (Mitchell, 2012; Williams, 2012).

should not be interpreted in separation (Jaccard et al., 1990; Jaccard & Turrisi, 2003). Before proceeding with the results of the multilevel modelling, key macro-level associations are discussed and selected descriptive statistics are presented reflecting on the research questions and hypotheses.

4.7 Results

4.7.1 Examining key macro-level associations

For this analysis a relatively small dataset of 172 countries is used, which is analysed by means of correlation coefficients, scatterplots and unadjusted regression modelling. This will allow having a snapshot picture of the strength and direction of the relationships under investigation as well as their statistical significance. Observing correlation patterns between the main variables of interest yields first conclusions. While country-level education is positively correlated with access to an improved water source ($r=0.7$, $p<0.01$), the remaining two relationships show opposite patterns. Thus, urban growth is negatively correlated with both education and access to improved water sources (Table 4.2).

Table 4.2 Correlation matrix of macro-level data.

	Education	**Urban growth**	**Water access**
Education	1.00		
Urban growth	-0.52***	1.00	
Water access	0.71***	-0.40***	1.00

Notes: Education is measured as mean years of schooling of adults above 25 (UNDP, 2010), urban growth is measured by the rate of annual urban growth between 2005 and 2010 (UN), and water access pertains to percentage of population with access to improved water sources (World Bank, 2010). *** indicates p-value of <0.01.

Before proceeding with the analysis of the household-level data, it is useful to inspect the results of an unadjusted macro-level regression and to examine the presumed effect of the interaction trend between urban growth and human capital. These are reported in Tables 4.3 and 4.4. While significant negative effect of urban growth can be observed in the unadjusted model ($\beta=-3.3$, $p<0.01$), this impact is mitigated by countries' educational level. Thus, Table 4.4 shows a significant interaction term between education and urban growth

($p<0.1$), which also improves overall model fit (R^2 increases from 1.16 to 1.51). In order to facilitate the understanding of this interaction, predicted values are produced and plotted. These are shown in Figure 4.8. The value of urban growth was set at 2 per cent and the levels of countries' education included 2, 4, 6, 8 and 10 years of schooling. The results suggest a strongly significant effect of human capital on the otherwise negative impact of macro-level urban growth. Before multilevel modelling is undertaken to further investigate these associations, the next section focuses on disentangling the patterns in household-level data based on the Demographic and Health Surveys.

Table 4.3 Regression results of unadjusted model testing the effects of macro-level urban growth.

Access to SDW	β	SE	z	P>z	95% CI	
Urban growth	-3.27	0.57	-5.74	0.00	-4.40	-2.15
Constant	94.48	1.72	55.04	0.00	91.09	97.87
n= 172						
R^2=0.16						

Table 4.4 Regression results testing macro-level interaction effects.

Access to SDW	β	SE	z	P>z	95% CI	
Urban growth	-3.16	1.70	-1.86	0.07	-6.51	0.19
Education	2.57	0.62	4.15	0.00	1.35	3.80
Urban growth*education	0.39	0.21	1.89	0.06	-0.02	0.80
Constant	68.99	5.92	11.65	0.00	57.29	80.69
n= 160						
R^2=0.51						

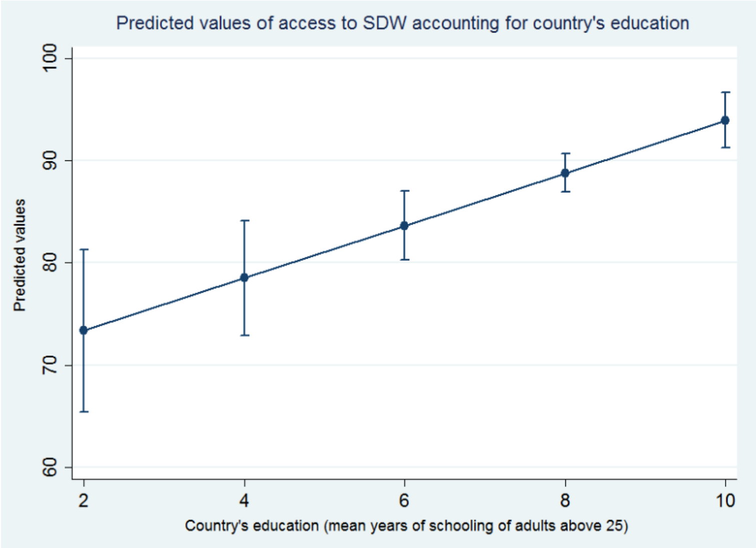

Figure 4.8 Predicted values of access to safe drinking water by country' education (% of population with access to SDW).

Note: The value of urban growth was held constant (rate of urban growth = 2 per cent).

4.7.2 Descriptive statistics of DHS data

This section presents the results of descriptive statistics for household-level data. The underlying data patterns are investigated by means of bar graphs, box plots, cross-tabulations and statistical significance tests. Table 4.5 and Figure 4.9 display the patterns of access to safe drinking water by households' place of residence and human capital. The results are categorised both by urban-rural differentials and by four types of residence, based on the DHS classification. While overall 85 per cent of urban households benefit from water access, in rural areas this proportion drops to 63 per cent. However, when the households are divided by their level of human capital (based on the median distribution of the variable), these differences are further exacerbated. Thus, 88 per cent of urban households with higher levels of human capital have access to safe drinking water as compared to 78 per cent of urban households with lower human capital. Similarly, when considering rural households, only 57 per cent of households with a lower level of human capital enjoy access to safe drinking water, whereas this proportion increases to 72 per cent for households with higher human capital. When the data are further disaggregated by type of residence, more nuanced patterns emerge. The data by disaggregated type of residence are only available for nine countries.[28] The total number of observations included in this analysis is 96,874. As presented in Figure 4.10, while in large cities there is almost no difference in terms of the potential impact of households' human capital, all other categories show considerable variations. In particular, the potential mitigating effect of human capital appears to be most pronounced for households residing in towns and countryside.

Table 4.5 Cross-tabulation of access to safe drinking water by residence and level of human capital.

	Access to safe drinking water				
	Low human capital		High human capital		All
Place of residence	**% with access**	**significance**	**% with access**	**significance**	**% with access**
urban	78.37	X^2=(2,500)***	88.22	X^2=(3,600)***	85.23
rural	57.45		71.82		63.39
Type of residence					
large city	88.97	X^2=(1,600)***	88.98	X^2=(2,500)***	88.81
small city	80.22		89.84		86.37
town	58.66		79.00		69.99
countryside	53.35		65.61		58.69

Note: Low human capital refers to values of below median, while high human capital refers to values equal to or above median. *** denotes statistical significance at 1 per cent level. In addition, statistical significance across HC levels was tested and was also proved statistically significant at 1 per cent level (except large cities).

[28] The nine countries consist of Bangladesh, Congo (Democratic Republic), Liberia, Mali, Malawi, Sierra Leone, Tanzania, Uganda and Zambia.

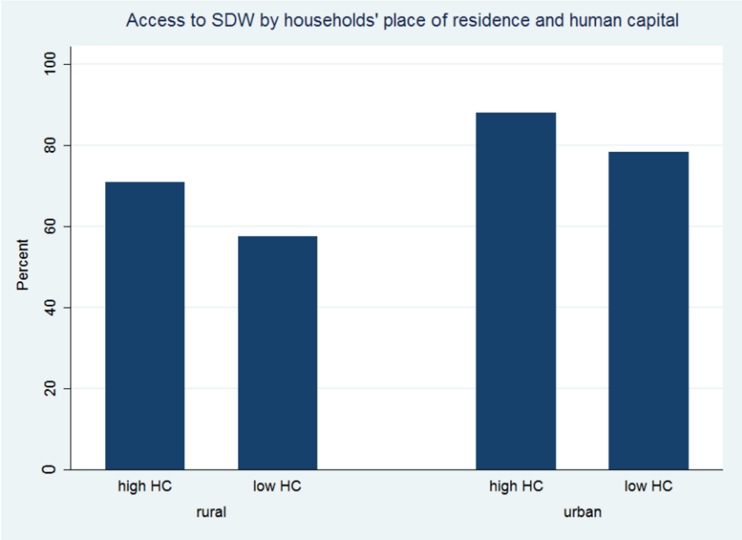

Figure 4.9 Patterns in access to safe drinking water (SDW) by households' place of residence and level of human capital (HC).

Note: Low human capital refers to values of below median, while high human capital refers to values equal or above median.

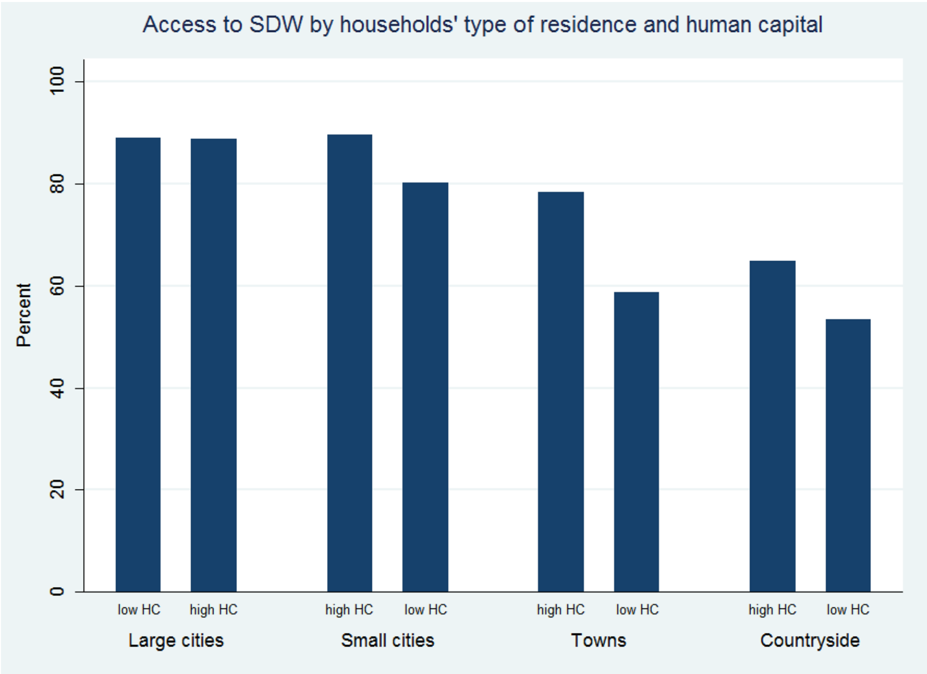

Figure 4.10 Patterns in access to safe drinking water (SDW) by households' type of residence and level of human capital (HC).

Note: Level of human capital defined as in Figure 4.9.

The second step in this analysis is to investigate the distribution in households' human capital by place and type of residence for those households that have access to safe drinking water. For this purpose, two sets of box plots have been constructed accompanied by statistical tests of significance. In this case, households' human capital is measured by continuous variable of households' mean education (of household members of working ages only). The statistical significance of between-group differences was first investigated by means of the ANOVA tests. However, because Bartlett's statistics rejected ANOVA's assumption of equal variances across groups, non-parametric Kruskal-Wallis test was eventually applied as suggested by MacDonald (2011). According to the Kruskal-Wallis test, a very small p-value indicates that the between-group difference is statistically significant, which was the case in this analysis. For information, the results of both ANOVA and Bartlett's tests are provided in Appendix I.

As can be deducted from the graphs below (Figures 4.11 and 4.12), educational attainment of all households varies greatly depending on their place of residence. As expected, the traditional urban bias persists. In urban areas the mean household education for those households with access to safe drinking water is approximately 5 years. On the other hand, households with access to safe drinking water but living in rural areas have on average 2.8 years of education. When urban-rural differentials are further disaggregated into large cities, small cities, towns and countryside, it can be observed that there is a significant variation between different types of urban settlements. Thus, educational attainment is highest in large cities and small cities (with respective means of over 5.4 and over 4.5 years of education) (Table 4.6). In addition, lowest levels of human capital can be noted for households residing in towns and the countryside, showing that special attention should be paid to rural and peri-urban areas. For all spatial groups, the graphical results show a large number of outliers, indicating that some households manage to obtain high educational level regardless of their place of residence.

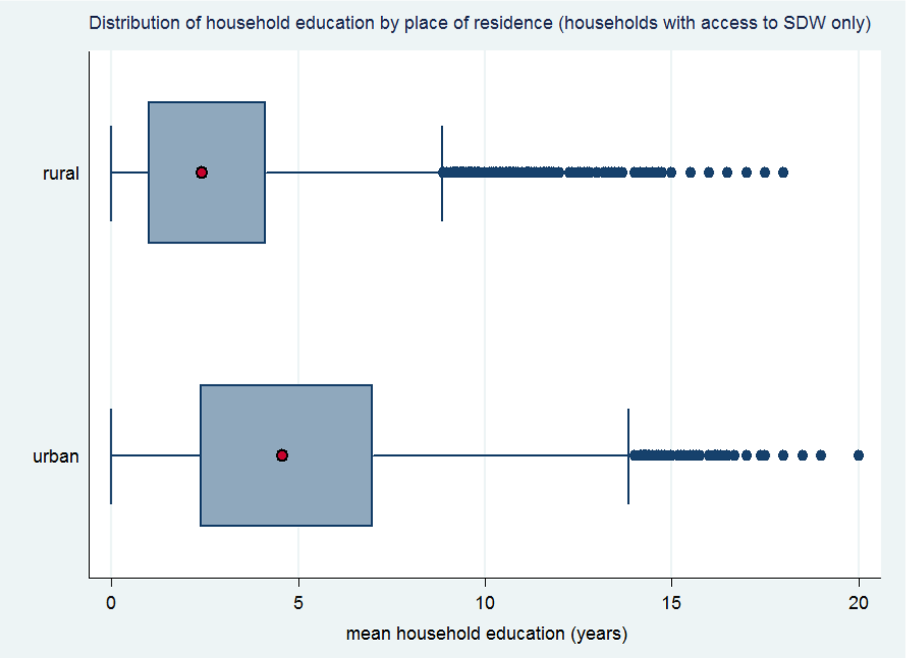

Figure 4.11 Household access to safe drinking water (SDW) by human capital and place of residence.

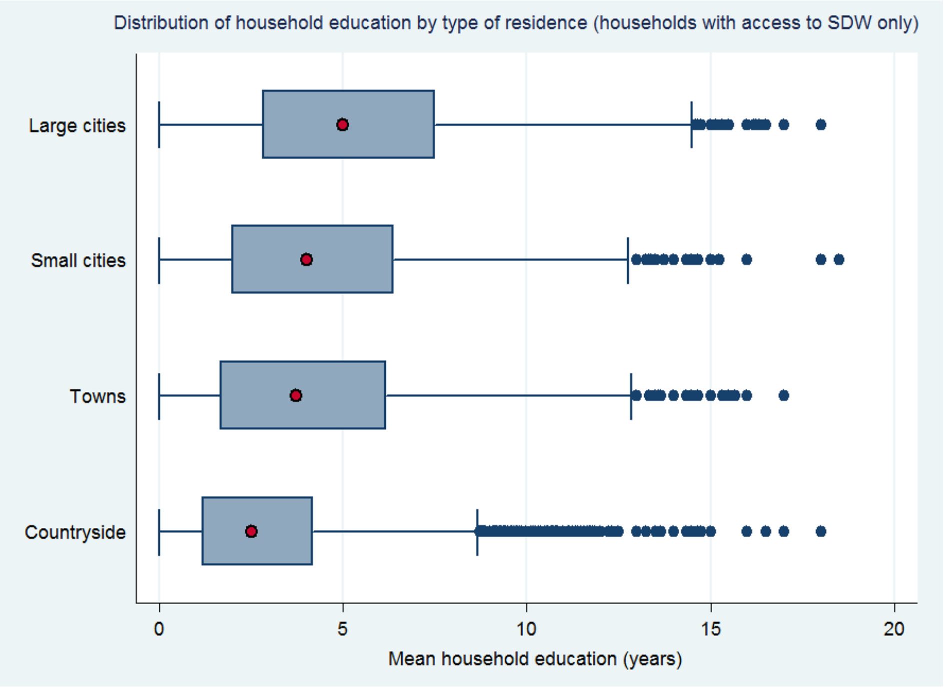

Figure 4.12 Household access to safe drinking water (SDW) by human capital and type of residence.

Table 4.6 Cross-tabulation of household education and place/type of residence.

	Household education			
Residence	Mean	Median	St. deviation	Kruskal-Wallis χ^2
rural	2.84	2.43	2.36	(13,618)***
urban	5.01	4.57	3.46	
large city	5.38	5.00	3.48	(5,049)***
small city	4.45	4.00	3.23	
town	4.22	3.71	3.25	
countryside	2.91	2.50	2.35	

Note: *** p≤0.01. Households with access to safe drinking water only.

Further analysis will allow drawing conclusions about the strength and direction of the underlying associations. At this stage, the descriptive statistics confirmed the assumption of the first preposition (section 4.4), which stated that residing in urban areas is likely to have a positive effect on both human capital and water access. In addition, the results of the macro-data analysis conducted in the previous section revealed a potentially negative impact of countries' rapid urban growth. Statistical testing of this chapter's hypotheses and propositions, including cross-level interactions, is the focus of the next section.

4.7.3 Multilevel logistic regression analysis

In this section, selected regression models are presented and discussed. The analysis involves several key steps. First, the effects of the main variables, i.e. those measuring urbanisation and household education, are tested. Then, the impact of including confounding factors is investigated. The interpretation of the results for each model is presented sequentially.

Before discussing the findings of the selected multilevel logistic models, it is sensible to highlight the results of the empty multilevel model, which tests for country effects (Table J1 in Appendix J). The significant variance in this model and the likelihood ratio test indicate that there is strong evidence of between-country differences. In addition, the *serrbar* diagram (Figure J1), which allows graphical illustration of clustering effects, confirms significant variation in predicted country-level residuals. While the value for Bangladesh is the highest one and could be argued to be an outlier, after careful inspection of the data it has been decided to not to remove the country from the sample. In addition, because Bangladesh has been experiencing rapid urbanisation as well and challenges in access to safe drinking water it constitutes a valuable source of relevant data.

The results of the selected regression models are presented in Tables 4.7 (Models 1-4) and 4.8 (Models 5-6). The unadjusted regression (Model 1) confirmed that urban-rural differentials play a significant role in terms of influencing households' access to safe drinking water. The odds ratio of 4.65 ($p<0.01$) for urban place of residence indicates, that controlling for country effects, urban dwellers are 4.65 times more likely to have access to a source of safe drinking water as compared to the residents of rural areas. Guided by the research questions pertaining to the mitigating impact of human capital, Model 2 incorporates an interaction effect between place of residence and households' education. As expected, the interaction term is statistically significant ($p<0.01$). In order to facilitate the interpretation of the interaction effect, predicted odds were calculated for selected combinations of household education and place of residence. These are included in Table J4 (Appendix J) and presented graphically in Figure 4.13. While the micro-level urban-rural divide persists, education has a significant positive effect on households' water access, regardless of the place of residence. Thus, based on the results of Model 2, for urban households with no education at all the odds of accessing safe drinking water are 5.1 as compared to over 13.1 for those with mean household education of eight years. In rural areas, the equivalent odds are 1.4 for households with no education and 3.6 for households with eight years of mean education. In addition, looking at the trends in predicted odds (Figure 4.13) it can be deducted that, as household education increases, the difference in predicted odds between rural and urban households intensifies.

Model 3 presents a more detailed disaggregation of urban areas into large cities, small cities, towns and countryside. When considering these results it is important to remember that the sample size for variables representing categorical type of residence is much smaller, around 48 per cent of the original sample size (n= 96,447). The results show that, while urban advantage persists, urban dwellers residing in large cities benefit from greatest chances of water access. Controlling for country effects, for urban households the odds of access to safe drinking water are almost 13 times higher than the equivalent odds in the countryside. On the other hand, for the residents of towns these odds are much lower (OR=3.4, $p<0.01$). Model 4 incorporates interaction effects between type of residence and households' education as well as a number of confounding variables, which represent household characteristics. The controlling variables in this model include the number of household members, sex of the household's head, time spent to fetch water and type of wall material (as an approximation of wealth). Interaction effects between household level of education and type of residence are all significant ($p<0.01$). In all types of residence the odds of accessing safe drinking water increase along with the greater human capital. Thus, for example, based on the results of Model 4 in large cities households with no education have predicted odds of access to SDW of 8.4, while households with eight years of education have odds of 16.4. The graphical illustration of interaction effects is presented in Figure J2 (Appendix J).

As far as confounding factors are concerned, several household characteristics as well as overall country effects have a significant impact on households' ability to access improved water sources. The results show that households with a female head of household have a greater probability of accessing safe drinking water. This is an expected outcome as in many developing countries females are likely to be in charge of collecting and managing water at the household level (Crow & Sultana, 2002; Willetts et al., 2010). Based on the results in Model 4, controlling for other confounding factors, households with a female head of household are 1.22 times more likely to access safe drinking water as compared to households with a male head of household. As expected, the amount of time needed to fetch water has a negative influence on households' ability to exercise their right to water. Those households that reside far from a water source, or that do not have easy access to water due to lack of adequate infrastructure are at a disadvantage. Not surprisingly, households' wealth (as approximated by wall material) shows a strong positive effect on water access. Households with finished and rudimentary wall material are around 1.7 times more likely to have access to SDW as compared to households with natural wall material. It is noteworthy that, in an unadjusted regression with wall material as the only explanatory variable, the strength of this association further increases; households with finished wall material have OR of 3.35 (the baseline category being natural wall material).

Table 4.7 Regression results for selected models (1).

Access to SDW	Estimated ORs and CIs			
	Model 1	**Model 2**	**Model 3**	**Model 4**
Independent variables				
Urban	4.65 (4.52; 4.78)***	3.29 (3.15; 3.44)***		
baseline: rural	1.00	1.00		
Large city			12.86 (11.99; 13.79)***	9.93 (8.77; 11.25)***
Small city			8.14 (7.49; 8.85)***	4.57 (4.01; 5.20)***
Town			3.41 (3.25; 3.59)***	2.04 (1.89; 2.20)***
baseline: countryside			1.00	1.00
Household education		1.13 (1.12; 1.13)***		1.10 (1.08; 1.10)***
Household education*urban		1.02 (1.01; 1.03)***		
Household education*large city				0.94 (0.92; 0.96)***
Household education*small city				1.05 (1.02; 1.08)**
Household education*town				1.07 (1.05; 1.09)***
Number of household members				
1-4				0.77 (0.71; 0.84)***
5-7				0.85 (0.79; 0.92)***
8-10				0.92 (0.84; 1.00)**
baseline: more than 10				1.00
Female head of household				1.22 (1.17; 1.27)***
baseline: male				1.00
Household wall material				
Finished				1.72 (1.61; 1.84)***
Rudimentary				1.71 (1.63; 1.80)***
baseline: natural				1.00
Time to fetch water				
between 10 and 30 min				0.60 (0.58; 0.63)***
more than 30 min				0.53 (0.50; 0.55)***
baseline: less than 10 min				1.00
Constant	1.87 (1.18; 2.98)***	1.40 (0.89; 2.19)	1.06 (0.47; 2.39)	1.23 (0.55; 2.75)
Country-level variance	1.07 (0.56; 2.01)	0.99 (0.52; 1.87)	1.54 (0.61; 3.87)	1.51 (0.60; 3.81)
n	200,507	193,427	96,447	92,133
Log pseudolikelihood	-106,207	-100,910	-50,709	-47,015
LR test vs. logistic regression	χ^2 = (24,693)***	χ^2 = (21,327)***	χ^2 = (17,563)***	χ^2 = (12,786)***

Note: * p≤0.1, ** p≤0.05, *** p≤0.01; Confidence Intervals (CIs) are reported in parentheses.

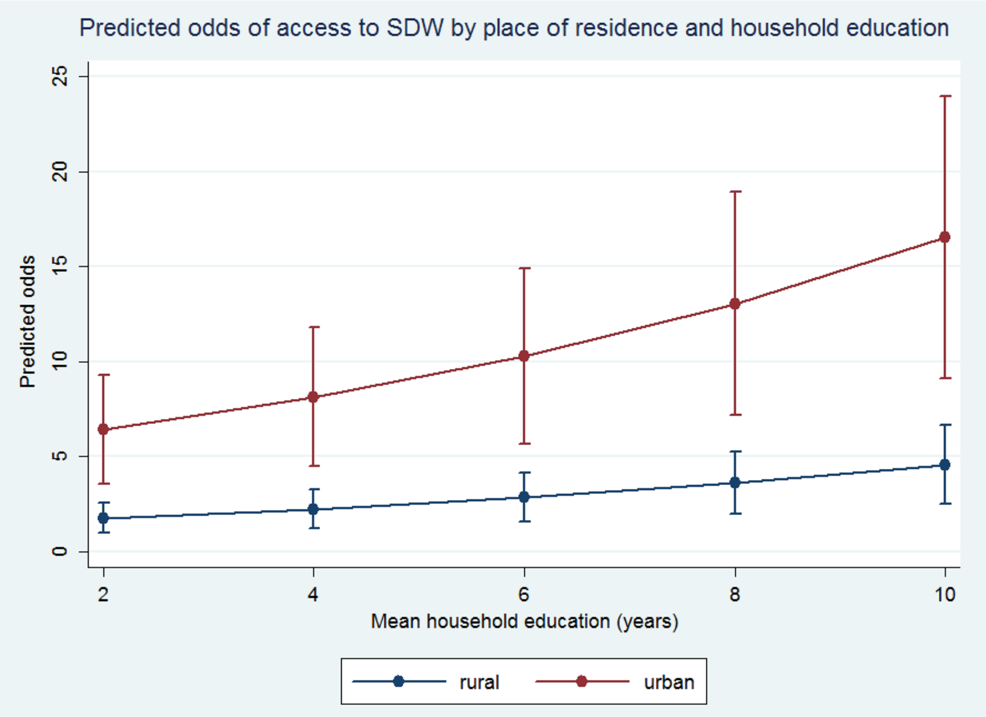

Figure 4.13 Predicted odds of accessing safe drinking water by place of residence and household education (based on Model 2).

Finally, Model 5 tests for the effect of macro-level urban growth, while Model 6 incorporates both micro-level and macro-level confounding factors and examines cross-level interactions. As can be noted (Table 4.8), urban growth has a significant negative effect on households' water access (OR=0.73, $p<0.01$). Thus, as the rate of urban growth increases, the probability of access to SDW is reduced. Model 6 complements the previous models by including interaction terms between urban growth and household education and proportion of urban population in slums and household education. Figures 4.14 - 4.15 provide a graphical representation of these interaction effects. Both graphs illustrate positive impact of households' human capital with predicted odds of access to safe drinking water increasing with greater human capital. For instance, when countries' urban growth is kept constant and controlling for other confounding factors included in Model 6, the odds of access to an improved water source for households with low human capital are 3.4, as compared to the odds of 5.6 for households with a higher level of human capital (Table 4.9). Similarly, human capital has a significant positive impact on the association between proportion of urban population in slums and water access. The predicted odds of accessing safe drinking water illustrate that, as households' human capital increases, so do the

Table 4.8 Regression results for selected models (2).

Access to SDW		
	Model 5	**Model 6**
Household characteristics		
Urban		2.72 (2.63; 2.80)***
Baseline: rural		1.00
Mean household education		1.14 (1.11; 1.18)***
Number of household members		
1-4		0.90 (0.86; 0.95)***
5-7		0.95 (0.91; 1.01)*
8-10		0.98 (0.93; 1.04)
baseline: more than 10		1.00
Female head of household		1.19 (1.16; 1.23)***
baseline: male		1.00
Household wall material		
Finished		1.30 (1.25; 1.35)***
Rudimentary		1.69 (1.61; 1.73)***
baseline: natural		1.00
Time to fetch water		
between 10 and 30 min		0.55 (0.54; 0.57)***
more than 30 min		0.41 (0.40; 0.43)***
baseline: less than 10 min		1.00
Contextual factors		
Urban growth	0.73 (0.72; 0.74)***	1.02 (0.62; 1.66)
Urban population in slums		0.99 (0.96; 1.02)
Population growth		0.51 (0.28; 0.94)**
Political stability		0.89 (0.57; 1.39)
Expenditure on education		1.13 (1.03; 1.23)**
Roads network		1.00 (0.98; 1.03)
Cross-level interactions		
Household education*Urban growth		0.95 (0.95; 0.96)***
Household education*Urban population in slums		1.003 (0.002; 1.003)***
Constant	8.23 (7.80; 8.68)***	26.30 (0.58; 1,183)*
Country-level variance		0.58 (0.31; 1.10)
n	200,507	191,599
Log pseudolikelihood	-122,291	-97,387
LR test vs. logistic regression		χ^2 = (12,974)***

Note: * p≤0.1, ** p≤0.05, *** p≤0.01; Confidence Intervals (CI) are reported in parentheses.

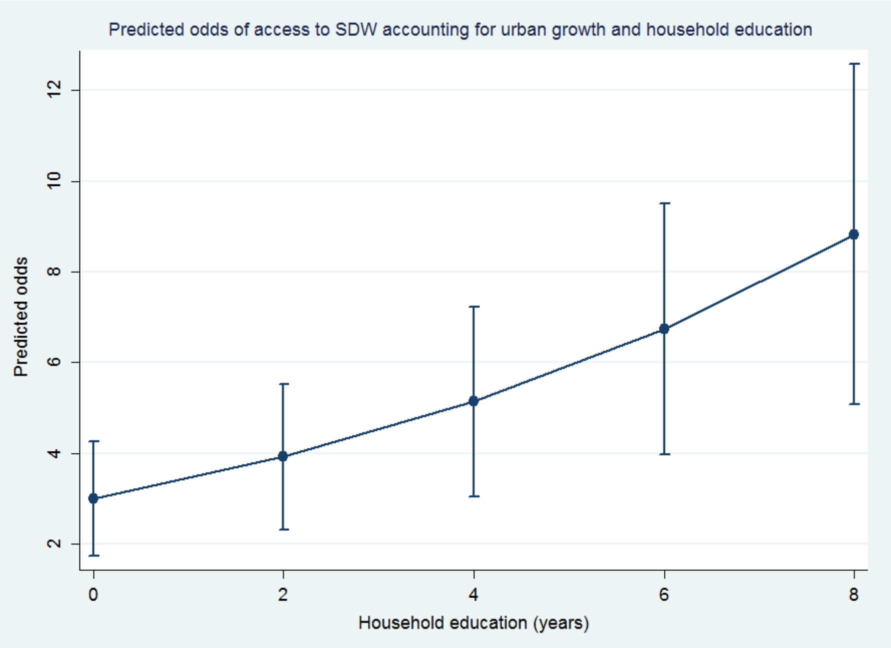

Figure 4.14 Predicted odds of accessing safe drinking water at different levels of human capital and mean value of urban growth (based on Model 6).

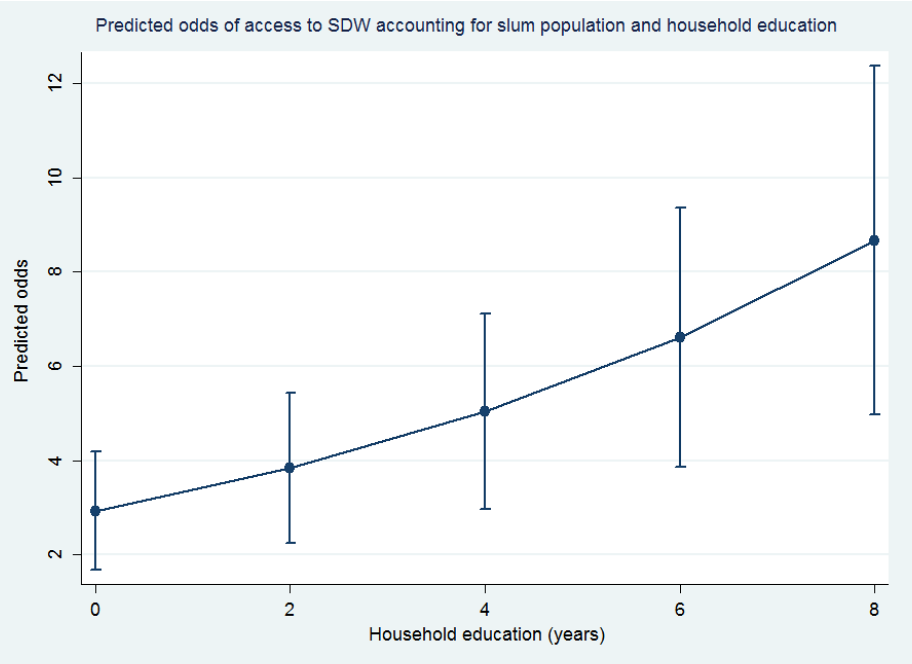

Figure 4.15 Predicted odds of accessing safe drinking water at different levels of human capital and mean value of urban population in slums (based on Model 6).

Table 4.9 Summary table of key associations and predicted odds based on Model 4.

	Urban growth		Slums	
Impact of urbanisation (direction of association)	↓		↓	
Impact of human capital	↑		↑	
Mean household education (quartile)	Q1	Q3	Q1	Q3
Predicted odds of access to SDW	3.4	5.6	3.4	5.5

Notes: Predicted odds are at mean values of variables "urban population in slums" and "rate of urban growth" (based on Model 6).

chances of water access, despite the fact that a considerable percentage of urban populations are slum dwellers. As an example, *ceteris paribus*, for households with low levels of education the predicted odds of accessing safe drinking water are 3.4, while for those households with higher levels of education the equivalent odds are 5.5.

As far as confounding factors are concerned, several household characteristics as well as overall country effects have a significant impact on households' ability to access improved water sources. As in Model 4, households with a female head of household are more likely to access SDW (OR=1.19, $p<0.01$). Similarly, household wealth and distance to a water source are significant predictors of access to SDW. With regard to the contextual factors, controlling for other variables included in Model 6, the rate of population growth is negatively associated with water access. This is an interesting finding when considered in conjunction with the positive effect of the number of household members on access to SDW. As with the rate of urban growth, the rate of population growth is likely to be associated with the impact of the process, rather than the population size itself. Nonetheless, it provides certain support for the traditional Malthusian arguments. In addition, other contextual variables, such as political stability, and expenditure on education and roads networks are not statistically significant as confounding factors. However, it should be stressed that when analysed separately in unadjusted models (as the only explanatory variable of access to SDW) all these variables are statistically significant and have a positive effect on water access. Finally, it should be noted that the models were tested for community effects; however, they proved statically insignificant and therefore of no substantial interest in this study.

4.8 Discussion and conclusions

Motivated by the Malthusian theory and post-Malthusian debate about the availability of and access to natural resources, this study had two main objectives. These were 1) assessing the impact of urbanisation on access to safe drinking water in the least developed countries, and 2) investigating the mitigating impact of human capital on the association between urbanisation and water access. In addition, the study aimed at examining the effect of key confounding factors, such as infrastructure and households' size, on access to SDW. To the best of the author's knowledge, this is one of the first systematic analyses which addressed the mitigating impact of human capital on vital resources using the case of safe drinking water. This study adapted the Simonian line of argument related to the power of human capital as the *ultimate resource* (Simon, 1981). Both empirical examples cited in the chapter, in particular in sections 4.2-4.4, as well as quantitative analysis confirmed these assumptions. It has been discussed in Chapter 2 that, while Malthus acknowledged the role of "wholesome cities" as a positive check, he failed to fully incorporate the impact of urbanisation on households' subsistence, measured as access to food and water. In this context, the contribution of this chapter to the Malthusian framework has been twofold. First, it has revealed that while urban bias persists, in the least developed settings urbanisation can act as a contemporary positive post-Malthusian check. Second, the study showed that the power of this check can be mitigated by households' human capital.

Using both descriptive statistics and regression modelling, the present study confirmed the complex nature of urbanisation, which cannot be classified as simply "good" or "bad". The results showed that large cities are significantly better off when it comes to access to safe drinking water. This is likely to be the result of greater infrastructure in large cities as compared to tons ad peri-urban areas. In addition, contextual variables suggest that the effect of urbanisation is not unidirectional. Thus, macro-level urban growth and proportion of urban population in slums have a significant negative impact on households' water access. This negative impact of the rate of urban growth can be explained by the fact that, in the LDCs, speedy urbanisation is often unplanned and thus can result in environmental degradation and large slum settlements, which are in turn associated with poor hygiene and ill health. The effect of the rate of urban growth on access to safe drinking water is attenuated by households' level of human capital. Moreover; factors, such as distance to a water source and macro-level rate of population growth have been confirmed to be significant direct predictors of access to safe drinking water. Finally, it should be also noticed that the findings of this chapter have confirmed that an urban-rural dichotomy continues to exist, regardless of the changing urban dynamics as pertains to water access. A summary of the hypotheses and observed results is provided in Table 4.10.

Table 4.10 Comparison of predictions and findings.

Hypothesis	Result	Comment
There is a positive association between urban residence and access to safe drinking water in the least developed countries.	H_0 has been rejected	A significant positive association has been found between urban residence and access to SWD. The strength of this association further varies depending on the type of urban residence).
Residents of large cities have better access to safe drinking water compared to rural residents and those in other urban locations.	H_0 has been rejected	Households in large cities are around 12.9 times more likely to have access to SDW as compared to households in the countryside.
In the LDCs, macro-level rapid urban growth has a negative effect on households' water access.	H_0 has been rejected	Macro-level urban growth has a negative impact on households' access to safe drinking water.
Human capital has a modifying impact on the association between type of residence and households' access to safe drinking water.	H_0 has been rejected	Human capital has a significant positive impact on the association between type of residence and access to SDW.
Human capital has a mitigating effect on the relationship between urban growth and water access.	H_0 has been rejected	Human capital mitigates the association between urban growth and access to SDW.

This research complements the existing evidence on the differentiated impact of urbanisation. On the one hand, numerous studies have confirmed that urban-rural differentials in access to safe drinking water remain a continuing challenge (WHO & UNICEFF, 2006; WHO, 2012; World Bank & IMF, 2013). On the other hand, however, research has highlighted that, in the developing world, rapid urban growth can constitute a threat to households' water access as well as to the natural habitat, more broadly (Smith & Darwall, 2006; McDonald et al., 2011; Cook & Murray, 2013). A recent report by the UN (WHO, 2012) pointed out that hasty urbanisation is likely to put further pressure on already strained water and sanitation infrastructure. As pointed out previously, to the best of the author's knowledge no prior research has been conducted on the mitigating effect of human capital on the association between urbanisation and water access. Several studies have, however, found that a direct positive association existed between education on access to improved water sources in Ethiopia and Ghana (Asante et al., 2002; Engel et al., 2005; Abebaw et al., 2010). Given the important health consequences of access to safe drinking water, the findings of this research can be used in conjunction with studies analysing health outcomes, in particular when it comes to waterborne diseases. In terms of the controlling factors, this research confirmed the existing evidence concerning gender differentials resulting from greater involvement of women in water provision (Crow & Sultana, 2002; Abebaw et al., 2010; Willetts et al., 2010).

While the present research advanced the knowledge in the areas of post-Malthusian and developmental studies, several limitations should be acknowledged. The first one refers to the constraints attributed to the indicator used for safe and unsafe drinking water. As pointed out in section 4.1, the imperfect side of the UN indicator measuring access to safe drinking water pertains to the fact that it fails to account for the actual quality of water in different water sources as well as water sustainability. As stressed by Satterthwaite and Mitlin (2013), a considerable proportion of people who are classified as having access to an improved source of water and/or sanitation are deprived of facilities which would enable them to satisfy basic health needs. The second limitation can be attributed to analysing cross-sectional data. While using panel data would be likely to yield more powerful results and capture more comprehensively the impact of the speed of urban growth, data and time limitations prevented the author from applying such approach. Finally, the third limitation relates to the overall classification of urban and rural settlements. While this issue is beyond the research undertaken in this chapter, it should be stressed that urban-rural classifications have been a subject of extensive scholarly debates (Satterthwaite & Tacoli, 2003; Jones, 2004). This issue has been discussed in detail in section 2.3.4 and a list of national definitions of urban areas is enclosed in Appendix B.

As a final word, a number of general reflections should be conveyed. It has been mentioned earlier in this chapter that access to safe drinking water has been recognised as a basic human right (UNESCO, 2006). Yet, as with other human rights, a question remains as to how to ensure that this right is being respected. In the context of rapid urbanisation, it is crucial that infrastructure and basic services are designed in a way that takes into account the needs of the country as a whole, including investments in rural areas. In this context, the recent suggestions by the Sustainable Development Solutions Network (SDSN) for sustainable development indicators on raising rural prosperity deserve credit (SDSN, 2013). Cohen (1995, 1996) argued that the issue of the Earth's carrying capacity is dependent on both natural conditions and human choices. This entails both individual or household-level choices as well as favourable contextual dynamics, often defined by government policies. Therefore, hotspots of deprivation in terms of provision of education ought to be identified and access to universal schooling guaranteed by law. In parallel, an enabling regulatory environment should be created in order to facilitate research and development, also in the private sector. Civil society groups are best positioned to engage in relevant initiatives and develop efficient lobbying strategies for the benefit of their communities. In order to reach out to large spectra of the society, the use of traditional media channels and social media should accompany the above mentioned processes. As this research has confirmed, both urban-rural and intra-urban inequalities exist and, with continuing hasty urbanisation in the LDCs, the latter are likely to grow. The topic of intra-urban inequalities in the context of the rapid pace of urbanisation will be the subject of the next chapter.

CHAPTER 5 IS RAPID URBANISATION EXACERBATING INTRA-URBAN INEQUALITIES IN NUTRITIONAL OUTCOMES? EVIDENCE FROM THE LEAST DEVELOPED COUNTRIES

Abstract – Increasing poverty and poor access to basic means of subsistence in urban areas have recently become subject to intense scholarly inquiry. Yet, little comparative analysis has been conducted that would investigate the extent of intra-urban inequalities in health outcomes presumably attributable to the rapid pace of urbanisation. Within the broader context of population and development, this research examines the magnitude of wealth-based intra-urban inequalities in child health in the least developed countries (LDCs), with a focus on under-nutrition. The extent of these inequalities is investigated by classifying countries according to their pace of urbanisation, with five most rapidly urbanising LDCs and five less rapidly urbanising LDCs. Data are drawn from the recent Demographic and Health Surveys conducted during 2005-11. The analysis based on both individual country and pooled datasets considered inequality measures such as concentration indices and concentration curves, as well as logistic regression techniques with underweight and stunting as dependent variables. Results confirm significant inequalities in children's nutritional outcomes, and that these inequalities are greater in the most rapidly urbanising LDCs. The wealth effects in these countries were strong, suggesting that children born in economically disadvantaged households were significantly more likely to be undernourished. Mozambique and Burundi showed greatest intra-urban inequalities in underweight. Finally, the results of the logistic regression confirmed that mother's education and child's birth weight are strong significant predictors of a child's undernutrition and that community effects have a significant effect on child health outcomes.[29]

Key words: Malthusian theory, urbanisation, undernutrition, inequalities, children, least developed countries

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[29] Paper entitled "Is rapid urbanization exacerbating intra-urban inequalities in child health? The case of the least developed countries" is currently under review in *Population and Development Review.*

> *"It has appeared, that from the inevitable laws of nature some human beings must suffer from want. These are the unhappy persons who, in the great lottery of life, have drawn a blank" (Malthus, 1798, p.74).*

> *"We have a collective responsibility to uphold the principles of human dignity, equality and equity at the global level. As leaders we have a duty therefore to all the world's people, especially the most vulnerable and, in particular, the children of the world, to whom the future belongs" (United Nations, 2000).*

5.1 Introduction

Today, the majority of the human population resides in urban areas and urban sprawl is projected to continue. Least developed countries continue to experience both rapid demographic and urban growth. As these countries often lack basic means of subsistence, infrastructure and access to education, increasing urban inequalities pose additional societal challenges. At the same time, it has been estimated that children and youth (0-19 years old) born in urban areas account for 60 per cent of overall urban growth (UNICEF, 2012b). Instead of reaping the benefits of the demographic dividend, the most vulnerable nations struggle with a growing number of children affected by urban poverty and poor health status. The human rights of children, including the basic right to survival, as stipulated in the 1989 Convention on the Rights of the Child (UN, 1989), are often violated. This is due to the fact that a considerable number of children in the LDCs lack access to the most basic necessities, such as safe water and nutritious food, which contributes to disconcerting rates of child mortality. While residing in urban areas has traditionally been associated with improving households' livelihood outcomes, rapid pace of urbanisation has contributed to greater urban poverty, thus exacerbating intra-urban inequalities. In this context, the present study aims to investigate the following primary research question:

1. Are wealth–based intra-urban inequalities in nutritional outcomes amongst children more severe in the least developed countries which have experienced the greatest pace of urbanisation?

Furthermore, the chapter's objective is to examine the following additional questions:

2. Does parents' educational capital have an impact on the extent on existing wealth inequalities? How do mother's social-economic attributes as well as children's

background characteristics contribute to children's nutritional status? Does controlling for these factors attenuate the impact of households' wealth? Do the strength and direction of the estimated associations differ between the most rapidly urbanising and the less rapidly urbanising LDCs?

The questions in this study have been motivated by both the Malthusian approach to poverty and inequalities (Malthus, 1798, 1826) and the contemporary developmental debate (UNECE et al., 2012; UNICEF, 2012b; Mitlin & Satterthwaite, 2013). Researching inequalities is not a new phenomenon. In the 18th century, Malthus argued that inequality should be viewed as the natural societal order. Inequalities exist because of human passion between the sexes and the limited capacity of the planet to produce food (otherwise, "the laws of nature" or "carrying capacity") (Elwell, 2001). In addition, inequalities can be perceived as having a positive impact on the society and individuals because they stimulate innovation, and thus societal progress. In an ideal situation, as Malthus claimed, inequalities would be minimal; however, no society can exist with only a middle class. While Malthusian arguments are certainly appealing, Malthus and his successors working in the area of population and development failed to recognise the multifaceted nature of inequalities, which goes beyond the labour supply-demand relationship. In addition, while today traditional urban-rural and income-based differentials continue to exist and constitute an important global challenge, the contribution of the structural factors, such as rapid urban growth, has seldom been investigated.

With an increasing number of urban poor, the UN (2012) has recognised that urban areas can no longer be uniformly associated with opportunities and prosperity. Inasmuch, social scholarship has confirmed the existence of large intra-urban inequalities, in particular with regard to health outcomes. Samir Basta (1977) reported that intra-urban differentials in health and nutritional status exceeded those between urban and rural areas. The detrimental impact of living in slums (as compared to other urban areas) on households' health conditions has been attested by recent research (Ompad et al., 2007; Martinez et al., 2008; Fotso et al., 2012). Geographers have argued that there exists a global "spatial segregation" which is linked to the place of residence (Skop, 2006). The implications of people's geographical habitat are thus far reaching, and have important consequences for the overall welfare of households and individuals, including their access to health and education. Crucially, as discussed in Chapter 4, macro-level processes of rapid unmanaged urban growth can lead to environmental degradation and lack of adequate housing. Those living in densely populated, poorly planned urban areas are at increased risk of malnutrition and infections including waterborne diseases and respiratory conditions.

While research has proved that overall there is a positive association between urbanisation and income, the cases of many African countries illustrate that rapid urbanisation can occur without economic growth (Clarke Annez & Buckley, 2009). On the one hand, in line with the traditional urban bias theory, the World Bank has argued that urbanisation benefits urban elites, while rural dwellers have been excluded from social protection and receive low compensation for agricultural produce (World Bank, 2000; Clarke Annez & Buckley, 2009). On the other hand, however, an increasing body of research documented child undernutrition in the context of urban poverty and proved that intra-urban inequalities can be greater than those occurring in rural areas (Menon et al., 2000; Fotso, 2006; Van de Poel et al., 2007).

Children in the developing countries are particularly threatened by undernutrition (Semba & Bloem, 2008). A recent report by UNICEF (2013) highlighted that globally one in four children under five is stunted. In some LDCs, including Timor-Leste, Burundi, Niger and Madagascar, the rates of stunting amongst children are as high as 50 per cent or more (UNICEF, 2013). In India, over 25 million of children are wasted, and more than 20 per cent of children have a birth weight of less than 2,500 grams (UNICEF, 2013). In addition, children are disproportionally affected by deaths resulting from environmental factors. These include such elements as water and sanitation, but also infrastructure and pollution. While globally 24 per cent of the disease burden is estimated to be a consequence of environmental problems, amongst children (0-14) the equivalent fraction amounts to 36 per cent (Prüss-Üstün et al., 2006). Diarrheal diseases and malaria constitute almost half of all disease factors contributing to the environmental burden of disease amongst children (Prüss-Üstün et al., 2006). In this context, rapid pace of urbanisation can be considered a key contributor to environmental degradation. A contaminated environment has a negative impact on children's nutrition, which consequently affects their overall health and educational outcomes.

Given the increasing variability within urban areas and the detrimental effect of environmental factors linked to rapid urbanisation, this study has three inter-related objectives. First, it aims to assess the scale of intra-urban inequalities in nutritional outcomes amongst children in the LDCs. Second, the goal of this research is to examine whether children in countries experiencing the most rapid pace of urbanisation suffer from greater intra-urban inequalities. Third, the study aims to test the impact of key explanatory factors, such as mother's socio-economic background and child's biological characteristics, on children's nutritional outcomes. Although the group of the least developed countries has often been treated jointly, in the last 30 years a number of LDCs have been subject to a particularly fast pace of urbanisation. The key assumption of this study is that this very rapid urbanisation is likely to (negatively) affect the extent of intra-urban inequalities in the countries under consideration. In order to fulfil the research objectives and answer the underlying research questions, the quantitative analysis in this study will test the following hypotheses:

H_1: Intra-urban inequalities in nutritional outcomes amongst children are greater in those least developed countries which have been experiencing most rapid urbanisation.

H_2: Parents' education has a modifying effect on the extent of intra-urban inequalities in nutritional outcomes in the LDCs.

H_3 Mother's socio-educational background is associated with children's undernutrition in the LDCs.

H_4: Low birth weight increases the risk of child undernutrition in the LDCs.

As highlighted previously, this study adapts both a macro-level and micro-level perspective. By using individual-level data, this research aims to identify associations between children. On the other hand, through the analysis of aggregated datasets, the study's focus is on the associations in most rapidly and less rapidly urbanising LDCs, considered as two separate groups. The most rapidly urbanising countries are Burkina Faso, Burundi, Mozambique, Nepal, and Rwanda, while less rapidly urbanising countries are Congo (DRC), Niger, Senegal, Sierra Leone and Zambia. The selection criteria were based on the pace of urbanisation over the last 30 years (1980-2010). The outcome of applying this benchmark was compared against the results of using other criteria (e.g. cumulative rate of urban growth); this testing largely confirmed the choice of study countries. While Chapter 3 focused on the concept of food insecurity, the emphasis of this study is solely on undernutrition. It is acknowledged that overweight and obesity also constitute a growing health challenge in sub-Saharan Africa. At the same time, however, globally one third of under-five deaths are linked to undernutrition (UNICEF, 2012a), and this proportion is likely to be higher in the least developed countries. Research found that, as the Z-scores of underweight and stunting decline, the risk of mortality increases (Black et al., 2008). In this chapter, child undernutrition is measured by standard (WHO) anthropometric indicators, including the indicators of stunting and underweight (age-for-height z-scores, and weight-for-height z-scores). In order to assess inequality patterns, the study uses well-established inequality measurement methods, such as ratios, concentration indices/concentration curves. The impact of key explanatory variables is assessed by means of logistic regression.

This chapter is organised as follows. The next section offers a brief discussion of the understanding and interpretation of inequalities in historical literature, including the Malthusian arguments. Section three offers a discussion of the nature of inequalities, highlighting the multi-disciplinary dimension of the phenomenon. Section four focuses on describing and discussing contemporary inequality trends in the context of rapid urbanisation. It also proposes a set of propositions with regard to urbanisation and child undernutrition. Section five provides a justification of country choice as well as a summary of the macro-level characteristics for all selected countries. Further sections describe the data and methods used and present the results of quantitative analysis. The final part of this chapter highlights the key findings, acknowledges study limitations and offers policy recommendations.

5.2 Historical discussion regarding inequalities in access to food

Inequalities are as old as the world itself. In hunting-gathering societies peoples' settlements were created based on the availability of food which would allow survival. People were constantly forced to move in search of their means of subsistence, which prevented a sedentary form of life. The survival of nomadic groups was conditioned on the physical strength of the group members as well as on the natural environment. Eventually, human innovation and technological advancements led to the evolution of hunting-gathering societies and the subsequent shift towards agriculture. For example, Boserup (1987) argued that in pre-industrial Europe population pressure triggered important changes in food supply techniques, including the use of forest land and natural pastures for crop production and feeding domestic animals on fallow land. Urbanisation was made possible by increasing population density and the surplus of agricultural produce. At the same time, ancient urban communities experienced high inequalities in terms of their living standards, including access to food (Boserup, 1981).

As highlighted in the previous section as well as in section 2.2.1, Malthus considered inequalities to be an indispensable element of societal construction. Following on from the functionalist-utilitarian line of argument, Malthus claimed that society had to be stratified because an eradication of the property rights would ultimately lead to uncontrolled population explosion. While Godwin's solution to the societal progress lay in improvement of institutions, Malthus claimed that institutional reforms had their limitations. This was again due to the intrinsic cause of inequalities which lay in the discrepancy between food available and the number of people to be nourished. In this context, inequalities existed because rational self-interested elites took advantage of their privileged situation in the society and avoided positive checks (Elwell, 2001). Thus, the burden of continuous reduction of population resulting from the laws of nature was carried by the poorest segments of the society.

In his writings on political economy Malthus outlined his argument from an economical perspective. He claimed that a larger class of wealthy individuals would create a greater demand for goods, and as such would be more beneficial to the economy as a whole. In his own words: "Thirty or forty proprietors with income averaging between one thousand and five thousand a year would create a much more effective demand for wheat, bread, good meat and manufactured products than a single proprietor possessing hindered thousand a year" (Malthus, 1836, p.374). This statement was part of a broader reasoning that, in order for a country to progress in its economic development, production and distribution are key and they have to be managed in adequate proportions. Malthus postulated that "production and distribution are the two grand elements of wealth, which, combined in their due proportions, are capable of carrying the riches and population of the earth … to the utmost limits of its possible resources" (Malthus, 1836, p.370). In order to assist the poor, but also to help ensure balance between consumption and production, Malthus supported maintaining a class of "unproductive consumers" through employment in public works (Malthus, 1836; Pancoast, 1943).

In addition to the management of the demand-supply dynamics, Malthus considered that narrowing of the inequality gap could be best achieved by wide-scale education of the poor. In that sense, he supported Smith's idea of expanding the system of parochial schools, but argued that teachings should also include the principle of population and self-determination of human destiny (Malthus, 1826, p.352). Malthus further stressed that teaching the principles of political economy to the lowest classes would bring invaluable benefits to the society as a whole. Education offered to the poorest people would allow them to approximate the habits of the middle classes and, thus, by increasing their prudence and delaying marriage, contribute to poverty elevation. Importantly, Malthus postulated that it was the duty of the governments to install a comprehensive educational system. Finally, Malthus was critical of financial aid to the poor, including the "Poor Laws", because he believed that it further aggravated their condition by providing incentives for reproduction. The limitation of the Malthusian line of thinking, as this thesis argues, lies in him underestimating the crucial role of historical urbanisation both in terms of changing the labour market and contributing to the health outcomes of urban residents. Studies in historical demography have shown that life expectancy was much lower in the cities as compared to the countryside, and that there existed considerable within-urban differentials (Szreter & Mooney, 1998; Harris, 2004). In addition, during Malthusian times, large inequalities existed in the distribution of food as well as in the quality and quantity of food consumed by different strata of the society (Harris, 2004). These inequalities were likely to be, at least partially, a result of rapid urbanisation.

Despite its shortcomings, the Malthusian theory has made a unique contribution to broadly understood population studies. Often without explicit acknowledgment, scholarly analysis of the origins of famines points out that unequal distribution of resources rather than crop failure are root causes of hunger and starvation. This unequal distribution can take place at different levels of analysis (region, district, less often household) and can be either national or international. The causes of unequal distribution entail economic and political factors. Thus, previously quoted Amartya Sen (1983b) argued that famines are strongly linked to the modes of production and class structure within a society. In an interview with David Barsamian (2001), Sen recalled that, during the Bengal famine, the poorest proportion of the society died, while the remaining 90-95 per cent of the population were unaffected. Sen (1983b) also pointed out that in many cases food exports continued from countries which suffered from famines. The examples include Ireland, who exported food to England during its great potato famine, despite the starvation of its own labouring class. It has been estimated that by 1851 Ireland had lost one-fifth of its population due to both death and mass emigration (Kearney, 2010).

Similarly, the contemporary discourse of African famines portrays the causes of these famines as the results of wars, natural disasters and corruption. Yet, the relationship between natural disasters and famines is not necessarily unidirectional. Influential research on African famines conducted by Michael Lofchie (1975) showed that droughts and famines are two distinct phenomena and that causes of African famines entail deep political and economic conditions of the societies rather than natural disasters. This is complemented by an agrarian paradox, where African agriculture fails to ensure adequate food production for local markets, while crops for exports are on the rise. In this context, internal urban-rural dynamics and increasing urbanisation of African countries play an important role when it comes to access to food. Although cities generate large demand for agricultural produce, the prices offered to cultivators are often so low that they are de facto encouraged to migrate to urban centres (Lofchie, 1975). The complex nature of inequalities will be further discussed in the next section.

5.3 The nature of inequalities

Inequalities are multifaceted and incorporate different aspects of human life. At the cross-functional level, inequalities can be linked to the standards of living, most often resulting from such factors as education and income. These inequalities are complemented by spatial features of human life which are related to the place of residence and consequently spatial access to basic necessities both in terms of human survival and opportunities for advancement. In addition, inequality patterns can operate at different levels of analysis, including macro and micro levels. The community-level support or lack thereof can be an important intermediary factor influencing the spread of inequalities, including in health outcomes.

Thus, at the individual level, a child from a poor family is likely to be more susceptible to the risk of undernutrition. A large body of evidence has documented considerable household-level inequalities, which also vary across countries (Menon et al., 2000; Wagstaff, 2002; Garcia, 2012; UNICEF, 2012a). These inequalities can be either exacerbated or attenuated by parents' education, behavioural factors and spatial aspects, such as household location. A conceptual framework developed by Wagstaff (2002) summarises the proximate determinants of health inequalities accounting for different levels of analysis. An increased risk of a negative outcome (or odds of success that such event occurs) is a derivative of household assets, including durable goods, income and human assets, as well as contextual factors. Finally, gender inequalities play an additional role. Gender-related inequalities can refer to the role of mother's socio-economic background, including education, as well as the importance of child's gender.

The extent of inequalities can be mitigated by effective government policies and transnational policies and laws, such as international trade agreements. While in the least developed countries, institutional welfare is limited or non-existent, many examples document successful pro-poor strategies. These include the government's contracting with local and international NGOs to scale up the provision of essential health services in Cambodia and upgrading essential obstetric care in Bangladesh with a goal to make it universally accessible (Gwatkin et al., 2005; Peters et al., 2008). Other examples include providing targeted health interventions to vulnerable and marginalised groups in the context of HIV/AIDS prevention and treatment (WHO, 2009; GFATM, 2011). With regard to improving nutritional outcomes, successful initiatives comprise those aiming at provision of micro-nutrients to the poor.

Drawing from the existing literature, and as illustrated by the above discussion, Figure 5.1 proposes a summary overview of the key aspects of inequalities. By incorporating the corresponding academic disciplines, it highlights the interdisciplinary character of the problem under investigation. While the framework was developed in the context of child undernutrition, it can be thought of as representing a universal nature of contemporary societal inequalities. The key aspects of the inequalities framework are: wealth, human capital, space, gender, social actors and population dynamics. At the household level, wealth can be measured by households' assets or expenditure, human capital can be quantified by the education of household members, spatial aspect refers to the place or type of residence, and demographic factors can include the number of household members. Social actors and institutions can influence the nature of inequalities through community-level initiatives and by shaping regulatory frameworks. These impacts can be assessed using both quantitative and qualitative tools. In addition, gender can refer to either the gender of the head of the household or the sex of individual household members. All these inequality aspects are influenced by the existing or anticipated policy frameworks. In addition to focusing on the contributing factors and levels of analysis, the framework integrates the issue of spread, or severity of inequalities, which can be either horizontal (cross-sectional) or vertical (time-related).

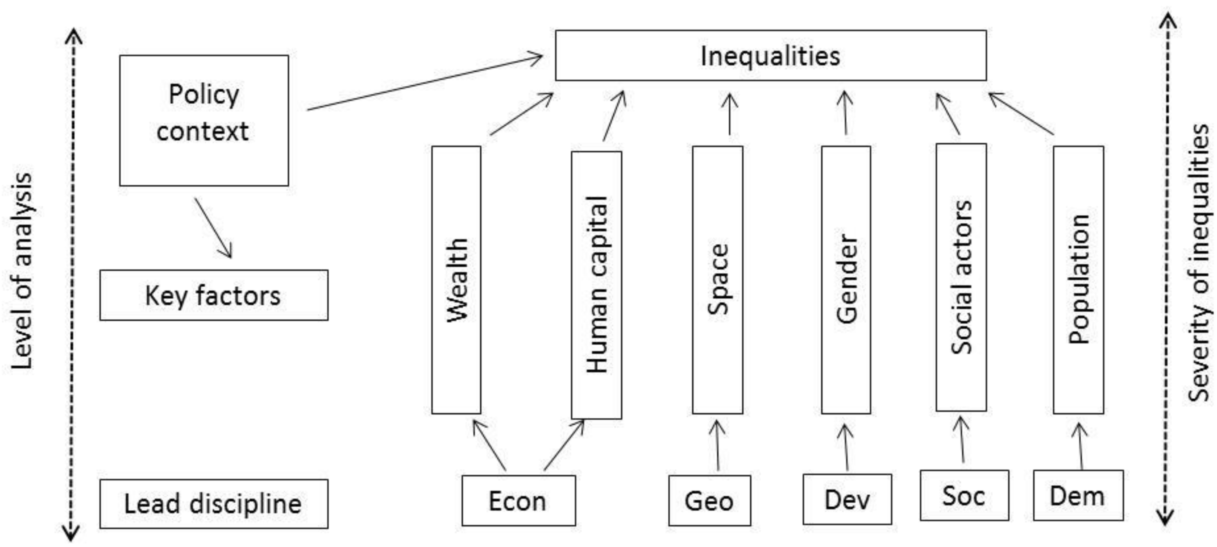

Figure 5.1 The nature of inequalities - an interdisciplinary framework.

It follows from the above that inequalities are not constant and their severity can change over space and time. Historically, countries have managed to implement successful policies and minimise the extent of inequalities in their respective societies. There is vast evidence that the historical European elites had wide access to food resources, which were unthreatened during the times of crises or famines (Livi Bacci, 1990). In some *milieux*, including the Court of King Erik in Sweden, daily diets exceeded 6,000 calories (Neveux, 1973; Livi Bacci, 1990). At the same time, the masses of (urban) poor were condemned to poverty and starvation, as documented in the history of famines from different continents (Livi Bacci, 1990; Dando, 2012). Regardless of the largely disputed by historical demographers association between nutrition and child mortality, today it has been recognised that the leading causes of child mortality, such as diarrhoea, pneumonia and malaria, are related to undernutrition (UNICEF, 2012a). As such, studying inequalities in nutritional outcomes is crucial not only to improving health and well-being of populations but also to increasing life expectancy. While in more developed countries the welfare state and technological advancements have contributed to the narrowing of the inequality gap, the LDCs continue to experience large societal inequalities, which are exacerbated by rapid urbanisation.

In addition to country-level changes in terms of inequalities in food access and nutritional outcomes, individual health status often evolves throughout one's life course. This in turn contributes to the macro-level developments when it comes to the nature and intensity of inequalities. It has been proved, for example, that children suffering from undernutrition are more prone to becoming obese in later life (Popkin et al., 1996; Sichieri et al., 2000; Sawaya et al., 2004). Also, because malnutrition is associated with higher risk of infection, an individual undernourished in their childhood can contribute to greater prevalence of infectious diseases in a particular country, or community. On the other hand, the socio-economic status of individuals can change, as can their place of residence. This in turn is likely to have implications for people's current health outcomes, as well as those of future generations. While it is important to highlight the different aspects of inequalities, the present study concerns itself with one assumed contributor to growing intra-urban inequalities, i.e. very rapid pace of urbanisation. In this context, the next section provides a brief overview of the contemporary intra-urban inequalities in child nutritional outcomes accounting for the pace of urbanisation.

5.4 Contemporary urbanisation and intra-urban inequalities in children's nutritional outcomes in the LDCs

5.4.1 Urbanisation and child undernutrition in the least developed countries

As mentioned previously, the group of the least developed countries was created by the UN's General Assembly in 1971 in order for the international community to pay greater attention to the needs of the most vulnerable nations (UNCTAD, 2011, 2012a). Currently forty-eight countries are classified as LDCs and most of them are geographically located in sub-Saharan Africa (UNCTAD, 2012b). In these countries weak economic systems, structural challenges and the inability of governments to provide growing urban populations with basic services are frequently mentioned amongst the key causes of this increased social stratification (Fotso, 2006). Additionally, it has been suggested that in Africa (where the majority of the LDCs are located) environmental challenges are amongst the drivers of urbanisation, constituting push rather than pull factors behind rapid urban growth. A paper by Barrios et al. (2006) found that in sub-Saharan Africa shortage of rainfall was positively associated with rural to urban migration and that this relationship was stronger in the post-colonial period. Irrespective of the causes of continuous urban growth, the consequences of increasing inequalities amongst urban populations deserve attention.

An "over rapid" pace of urbanisation can pose challenges to children's nutrition both in terms of greater overall poverty, which translates into barriers with access to food, and in increasing social stratification. As discussed in Chapters 3 and 4, unmanaged urban sprawl often results in large populations being forced to live in crowded, disease-prone environments, which are often illegal or semi-legal. Children are particularly vulnerable to the threats caused by poor urban environments both in terms of their physical and cognitive needs and opportunities for advancement. A recent report by UNICEF (2012b) highlighted that in 2010 eight million children under five died due to diseases, such as diarrhoea and pneumonia, as well as birth complications. Although no disaggregated data were reported so as to enable urban-rural comparison, it has been widely acknowledged that poor urban children are particularly at risk. In the context of the least developed countries, this urban risk is exacerbated by overall structural problems, including weak health systems. The trends in child undernutrition in the context of rapid urbanisation can be best analysed when considering relevant time series.

The World Bank's Development Indicators contain temporal data on child stunting from 1960. While for the early years the data for LDCs are unavailable, from 1980s the statistics become more frequently reported. This allowed plotting under-fives stunting data accounting for the pace of urbanisation of the corresponding country (Figure 5.2). The graph illustrates that although in both groups of the LDCs (more rapidly urbanising and less rapidly urbanising) the trends in stunting appear to be similar, countries which underwent more rapid pace of urbanisation have suffered from a relatively higher prevalence of child undernutrition. Even though caution is required when interpreting these patterns due to between-country variations, at the aggregate level the trends confirm the previous arguments regarding the presupposed negative effect of rapid urbanisation. The mechanisms through which the pace of urbanisation can influence children's nutritional outcomes are highlighted in the next section.

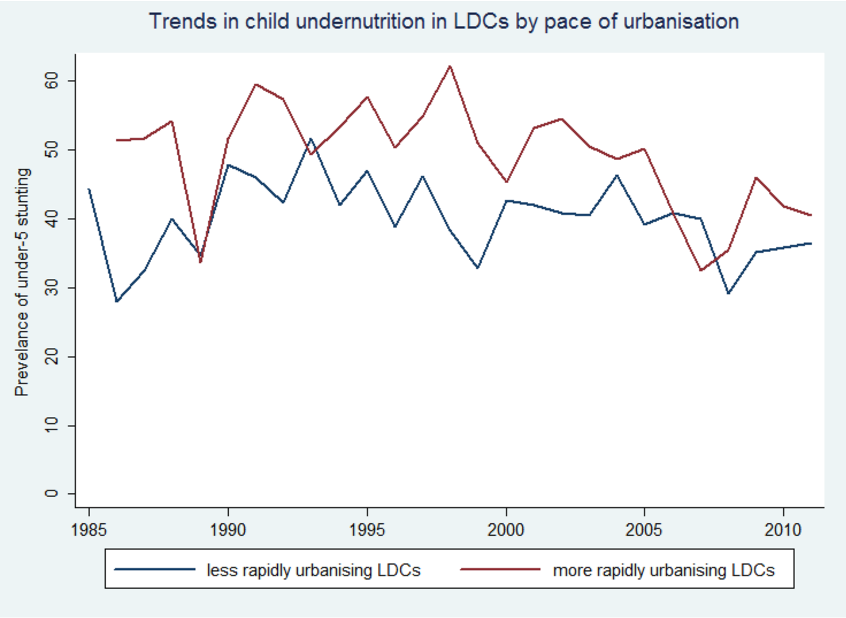

Figure 5.2 Trends in child undernutrition (stunting) in LDCs by pace of urbanisation (more rapid vs. less rapid).

5.4.2 Propositions regarding urbanisation and nutritional inequalities

More specifically, the presumed detrimental impact of the rapid pace of urbanisation on the intensity of intra-urban inequalities in nutritional outcomes can operate in a number of ways, including the following:

1. In the least developed contexts, rapid urbanisation is likely to put pressure on already weak institutions thus creating further barriers of access to support services for the poor.

Urbanisation without development is now a widely discussed phenomenon. Fotso (2006) highlighted that between 1980 and 2000 the urban population of sub-Saharan Africa grew by around 4.7 per cent, whereas the per capita GDP saw a yearly decline of almost 0.8 per cent. In a situation where support systems are limited, an additional demand for educational and health services generated by rapid urbanisation can exacerbate existing nutritional risks. At the same time, it has been proved that maternal health, including mental health, as well as educational background of the mother are strongly associated with nutritional outcomes of under-fives (Rahman et al., 2004; Subramanian et al., 2009; Arokiasamy et al., 2012). In this context, a strain on the national and local institutions and service providers can lead to greater health risks and poverty at the household and child level. For example, in Mozambique, which is one of the most rapidly urbanising countries, one-third of the population live in urban areas, with the majority residing in slums. A recent report on the urban sector in Mozambique (UNHABITAT, 2008) highlighted that, while overall the investments in poverty reduction have been successful, to a large extent they have been compromised by increasing urban poverty. Between 1997 and 2003, the national poverty ratio declined from 70 to 54 per cent; however, at the same time an increasing proportion of Maputo's population fell into poverty (UNHABITAT, 2008).

2. Rapid urbanisation triggers greater social stratification because of the dependence of the urban populations on labour market and price fluctuations.

Rapid pace of urbanisation can lead to social stratification, which is likely to involve greater inequalities in access to quality nutrition. Using the previously highlighted example of Mozambique, UNICEF (2006) reported that, in 2003, 29 per cent of urban children were stunted. Complementarily, an unpublished analysis of the most recent (2010) DHS data conducted by the author suggests that this figure has now exceeded 30 per cent. While more detailed data analysis will be provided in the *Results* section, it is important to highlight the key mechanisms through which urban stratification may occur and affect food distribution and affordability. Here, the issue of access to food is key. As discussed at length in Chapter 3 in the context of food insecurity, access to food can be both physical and financial. While urban populations often benefit from greater infrastructure, the urban poor are likely to encounter financial barriers in access to nutrition. In cities such as Maputo, Lima or Katmandu, households purchase more than 90 per cent of their food (Ruel et al., 2010). When opportunities for income generation are scarce, increases in the prices of food can have a dramatic effect. The Sahel food crisis, as discussed in Box 5.1, has had an exacerbating impact on an already dramatic prevalence of child undernutrition in the region.

This societal stratification resulting from dependency on income in order to ensure access to food can be further aggravated by spatial segregation. While the urban-rural differentials are often cited with regard to infrastructure, a matter of fact is that households in many African cities lack acess to electricity and water supply. Research has found that this weak infrastructure is associated with both demand and supply factors (Wodon et al., 2009). The reliance of urban dwellers on external sources of food combined with poor facilities are likely to be amongst the main sources of increasing intra-urban inequalities when it comes to children's nutritional outcomes. Finally, the existing stratification can be further influenced by growing environmental degradation and climate change.

3. Rapid pace of urbanisation accelerates environmental degradation and is a proven influencing factor with regard to climate change. As such, urbanisation indirectly augments the threat of child undernutrition, especially amongst the poorest.

Rapid urbanisation increases the risk of environmental push factors and thus contributes to greater migration flows (Myers & Kent, 1995; Myers, 2002). Myers and Kent (1995) identified a number of key factors influencing environmental exodus, including deforestation, water shortage, agricultural stress, soil erosion and landlessness. The authors acknowledge that urbanisation, and primarily the rise of mega-cities, has serious repercussions on environment and development, more generally. For example in densely populated urban areas of Bangladesh, including in the coastal delta regions, environmental hazards exacerbate existing threats to households' livelihoods (Banks et al., 2011; Islam, 2012; Hossain et al., 2014). While these relationships are often multidirectional, it would be difficult to argue against the fact that subsistence challenges faced by households are at least partially caused by rapid urbanisation, in particular in the context of the least developed countries.

Because urbanisation can have a negative impact on natural habitat, uncoordinated urban growth is likely to have an (indirect) adverse effect on child nutrition. A recent report by IFPRI (2009) provided a number of useful scenarios of the impact of climate change on agriculture using the indicators of per capita calorie availability as well as child undernourishment. The report noted that, accounting for climate change, by 2050 the per capita calorie availability in developing countries is likely to decline by 10 per cent. This trend is expected be worse in sub-Saharan Africa, where the decline may exceed 20 per

Box 5.1 Rapid urbanisation, famine and intra-urban inequalities in Burkina Faso.

Burkina Faso is one of the poorest countries in the world. According to the 2012 HDI ranking, Burkina Faso is the 5th poorest nation globally, preceded only by Chad, Mozambique, DRC and Niger (Malik, 2013). While the results of the 2009/10 household survey showed that since 2003 the incidence of poverty had decreased by 2.5 per cent, the recent (2009/2010) poverty rate remains worryingly high at 44 per cent (IMF, 2012). Importantly, while rural poverty dominates, the temporal trends reveal important messages. Between 1994 and 2009, Burkina Faso's rural poverty rates saw little fluctuation and remained at around 51-52 per cent, while the incidence of urban poverty experienced a twofold increase, reaching 20 per cent in 2009 (IMF, 2012).

The increase in urban poverty is linked to the rapid and largely unplanned urban growth. Since the mid-20th century, the proportion of urban population has continued to increase and it is projected to exceed 50 per cent by 2045. At the same time, the population of Ouagadougou, the capital city, grew from 33 thousand in 1950 to over 2 million in 2011. Today, more than 12 per cent of Burkina Faso's population reside in Ouagadougou (UN, 2011b). While today the rural-urban gap persists (Fofack, 2002; IMF, 2012), there has been a significant increase in the number of urban poor. The factors behind urban poverty in Burkina Faso are diverse and include such phenomena as climate conditions, limited purchasing power, age dependency, family size and governance issues (Ministry of Economy and Development, 2004). These conditions can lead to both temporary and chronic undernutrition.

In the last decade Burkina Faso suffered from three food crises, in 2005, 2005 and 2012. Most recently, in 2012, the Sahel food and nutrition crisis in West Africa, including Burkina Faso, has further contributed to aggravating the food insecurity situation in the country. The crisis triggered further population movements. Rural populations which were unable to produce sufficient agricultural yield migrated to cities in search of alternative income. Yet, high food prices and lack of income generation opportunities often constitute a barrier to food access in the cities. A recent study of child undernutrition in schoolchildren (7-14) in urban and peri-urban Ouagadougou showed that as children get older the nutritional concerns persist. It has been found that 57 per cent of the children showed more than one sign of malnutrition and that the majority of children who suffered from micronutrient deficiencies attended public schools (Dabone et al., 2011).

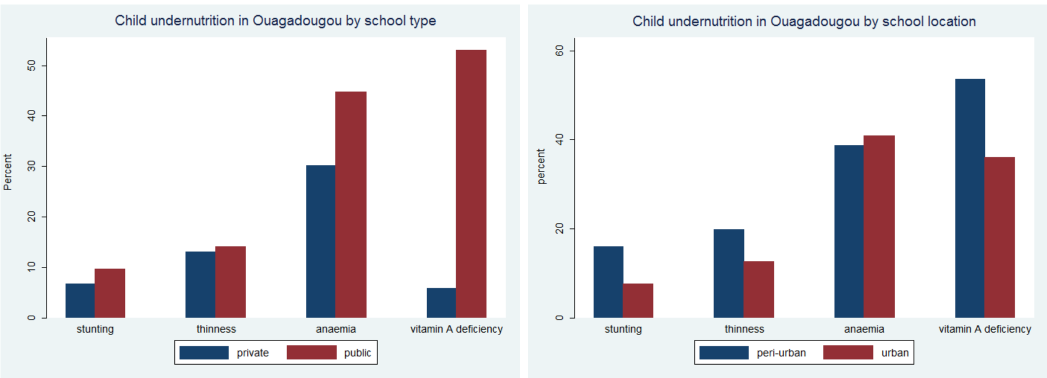

Figure 5.3 Child undernutrition in Ouagadougou by school type and school location.

Note: Data adapted from Dabone at al. (2011).

cent. At the same time the number of undernourished children in sub-Saharan Africa is projected to increase from an expected 42 to 52 million, as a result of climate change (Nelson & IFPRI, 2009). While climate change is a macro-level phenomenon, poorest populations are particularly at risk, which leads to further social stratification. Although a number of other interlinkages between rapid pace of urbanisation and child undernutrition are likely to exist, the relationships discussed above have been meant to provide a starting point for further debate and serve as a background for the methodological discussion, which is the focus of the next sections.

5.5 The choice of study countries

This study concerns itself with the case of the LDCs which are undergoing rapid urbanisation. As it considers both most urbanising countries and countries which have undergone less rapid urbanisation, the nature of this research is comparative. The selection of countries in this chapter was based on two main criteria. The first one involved the research questions and resulting research hypotheses. The second criterion was related to the availability of data, including access to recent surveys and availability of main variables of interest.

Regarding the first criterion, given that the main aim of this study is to investigate the extent of inequalities in rapidly urbanising least developing countries, the choice of cases was restricted to those nations that are classified as LDCs. Other options have been investigated, such as considering all developing countries; however, it was concluded that their contextual characteristics are too diverse to allow meaningful comparisons. The least developed countries, although constituting a varied group, by definition are situated in a similar developmental context and share a number of the same vulnerabilities (e.g. child undernutrition, food insecurity, access to safe drinking water). As highlighted previously, the current UN list of LDCs contains 48 countries[30].

The key selection and categorisation criterion was that of rapid urbanisation. In this context, the three most widely used variables are proportion of urban population, rate of urban growth and pace of urbanisation. Proportion of urban population is a static measure

[30] The list of LDCs in provided in Appendix A.

in a sense that it allows capturing the horizontal aspect of urbanisation and thus enables cross-country comparisons. Urban growth rate, on the other hand, facilitates detection of the rapidity with which urban populations increase. Eventually, pace of urbanisation, which is based on the percentage change of the proportion of urban populations over time, was considered to best capture the speed of urban sprawl. The cut-off points used are the last 30 years (1980-2010). No standard criteria exist and cut-off points are often arbitrary. Despite this fact, the chosen cut-off points are believed to well reflect the urban progress, which has been validated through comparison with other urban indicators.[31]

In addition to the macro-level considerations, practical constraints had to be taken into account. Because of the hypothesis-testing nature of this study, it has been evident from the outset that the research would make use of statistical tools. At the same time, although in many developing countries the survey data are rich and widely available, this pattern is not universal. Thus, the first practical limitation of the study involved restricting the selection of countries to those who have recent (post-2005) DHS datasets publically available. Some rapidly urbanising countries, such as Bhutan, are not part of the DHS project, while others, like Lao, had not released their datasets at the time this chapter was written. Secondly, amongst the datasets available, not all surveys contain key variables indispensable for this study, and hence could not be considered.

Tables 5.1 and 5.2 provide an overview of the selected macro-level statistics for the chosen study countries. These include indicators related to human development, i.e. the inequality-adjusted HDI, and population characteristics, as well as other relevant indicators, such as proportion of urban population with access to improved water sources and prevalence of child undernutrition. All selected countries suffer from different developmental challenges, which also vary in terms of their gravity and progress made. Thus, for example, in Rwanda only 76 per cent of the urban population benefit from access to improved water sources, while in Niger the equivalent coverage has now reached 100 per cent (World Bank, 2012b).

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[31] All most rapidly urbanised countries (based on the pace of urbanisation criterion) have also experienced high average annual urban growth (1890-2010); while all less rapidly urbanising countries have experienced average or below average annual urban growth (1980-2010). Only LDCs have been considered.

Table 5.1 Macro-level characteristics of study countries (most rapidly urbanising).

Selected macro-level characteristics of case study countries (most rapidly urbanising)					
	Burkina Faso	**Burundi**	**Mozambique**	**Nepal**	**Rwanda**
average annual urban growth, % (1980-2010)	6.32	5.35	5.05	5.65	7.00
pace of urbanisation, % (1980-2010)	192	145	136	173	298
proportion of urban population, % (2010)	25.7	10.60	31.0	16.7	18.8
population size, total (2012)	16,460,141	9,849,569	25,203,395	27,474,377	11,457,801
TFR (2011)	5.8	4.2	4.8	2.7	5.3
HDI value (2012)	0.343	0.355	0.327	0.463	0.434
Inequality-adjusted HDI value (2012)	0.226	n/a	0.220	0.304	0.287
net ODA received, % of GNI (2011)	9.6	24.8	16.7	4.7	20.2
geographic region (UN classification)	West Africa	Eastern Africa	Southern Africa	South-Central Asia	Eastern Africa
access to improved water sources, % of urban population with access (2010)	95	83	77	93	76
prevalence of stunting amongst children (% of children under 5)	35.1 (2009)	n/a	43.7 (2008)	40.5 (2011)	44.3 (2010)

Table 5.2 Macro-level characteristics of study countries (less rapidly urbanising).

Selected macro-level characteristics of case study countries (less rapidly urbanising)					
	Congo (DRC)	**Niger**	**Senegal**	**Sierra Leone**	**Zambia**
average annual urban growth, % (1980-2010)	3.51	4.14	3.33	3.03	2.63
pace of urbanisation, % (1980-2010)	17	31	18	34	-3
proportion of urban population, % (2011)	33.7	17.6	42.3	38.9	38.7
population size, total (2012)	65,705,093	17,157,042	13,726,021	5,978,727	14,075,099
TFR (2011)	5.7	7.0	4.7	4.9	6.3
HDI value (2012)	0.304	0.304	0.470	0.359	0.448
Inequality-adjusted HDI value (2012)	0.183	0.200	0.315	0.210	0.283
net ODA received, % of GNI (2012)	38.5	10.8	7.3	14.6	5.8
geographic region (UN classification)	Middle Africa	Western Africa	Western Africa	Western Africa	Eastern Africa
access to improved water sources, % of population with access (2010)	79	100	93	87	87
prevalence of stunting amongst children (% of children under 5)	n/a	n/a	28.7 (2011)	37.4 (2008)	n/a

In terms of undernutrition, comprehensive data are scarce, however literature as well as the data reported by UNICEF's Childinfo (2013) confirm existing (average-based) urban-rural disparities. Importantly, when examining the progress made by selected LDCs towards the MDG indicator of hunger (measured by child underweight), it can be deduced that at the aggregate level only two out of ten LDCs are on track towards the achievement of MDG 1. All other countries have either made insufficient progress or no progress at all (UNICEF, 2013).

Finally, it is important to highlight that, while HDI indictors and rankings for the selected countries are worryingly low, the inequality-adjusted HDI (IHDI) values reveal further reasons for concern. Based on the methodology adopted by UNDP, perfect equality exists when IHDI = HDI. The larger the difference between the two indices, the greater societal stratification (UNDP, 2013). Thus, by analysing the variations between the two indices one can observe that Nepal experiences the highest inequalities, while Congo (DRC) shows the lowest discrepancy between the two values. Although these statistics do not take into account the process of urbanisation, they provide an interesting background in the context of the present study.

5.6 Data and method

5.6.1 The datasets

This study makes use of the most recent available DHS data for the selected LDCs. In all ten countries considered in this chapter, survey fieldwork was conducted between 2005 and 2011. As highlighted previously (section 5.5), countries with the highest values of pace of urbanisation between 1980 and 2010 have been classified as most rapidly urbanising. Conversely, countries with the lowest scores in their pace of urbanisation have been classified as less rapidly urbanising[32]. The use of wording "less rapidly urbanising" rather than "least rapidly urbanising" has been preferred because most LDCs have been experiencing relatively rapid urbanisation. More specifically, the following DHS datasets have been used in the analyses sections:

- For most rapidly urbanising countries:

[32] As mentioned in section 5.5, pace of urbanisation is based on the change of the proportion of urban populations over time (1980-2010).

    - Burkina Faso: Standard DHS, 2010 (fieldwork conducted between May 2010 and January 2011);
    - Burundi: Standard DHS, 2010 (fieldwork conducted between August 2010 and January 2011);
    - Nepal: Standard DHS, 2011 (fieldwork conducted between January and June 2011);
    - Rwanda: Standard DHS, 2010 (fieldwork conducted between September 2010 and March 2011);
    - Mozambique: Standard DHS, 2011 (fieldwork conducted between June and November 2011).

- For less rapidly urbanising countries:

    - Congo (DRC): Standard DHS, 2007 (fieldwork conducted between January and August 2007);
    - Niger: Standard DHS, 2006 (fieldwork conducted between January and May 2006);
    - Senegal: Standard DHS, 2010-11 (fieldwork conducted between October 2010 and April 2011).
    - Sierra Leone: Standard DHS, 2008 (fieldwork conducted between April and June 2008).
    - Zambia: Standard DHS, 2007 (fieldwork conducted between April and October 2007).

In all datasets only observations for children and households residing in urban areas have been taken into account. Both separate and pooled datasets were used in order to provide a more comprehensive overview of nutritional inequalities. The breakdown of study sample by country is presented in Table 5.3. Key outcome variables considered in this study include the anthropometric indicators of undernutrition, as recommended by WHO. More specifically, the key outcome variables are child stunting and child underweight. Stunting measured as height for age z-scores (HAZ) has been widely used as an indicator of chronic undernutrition (Menon et al., 2000; Hoffman & Lee, 2005; Van de Poel et al., 2007; Arokiasamy et al., 2012; Srinivasan et al., 2013). Standard WHO cut-off point of HAZ of less than -2 SD from the reference population indicates that a child is stunted (-3SD are used for severe stunting). The indicator of stunting is particularly useful because it is associated with permanent growth retardation and as such influences productive capacity in later life (Hoffman & Lee, 2005). On the other hand, underweight (weight for age z-scores, or WAZ), which is a composite index, allows measuring both acute and chronic undernutrition. According to a reference publication by WHO (Fishman et al., 2004), underweight is the most widely used measure of child undernutrition in developing countries. Similarly to stunting, children with WAZ of two standard deviations below the reference median (-2SD) are classified as suffering from underweight (moderate or severe). Following previous evidence, the study by Fishman et al. (2004) confirmed that underweight is a significant predictor of direct causes of child mortality, such as diarrhoea, pneumonia, malaria and measles.

As far as explanatory variables are concerned, they included indicators measuring ownership of households' assets, mother's socio-economic characteristic and children's attributes. Mother's socio-economic background has been frequently reported as a significant predictor of child undernutrition. For example, an extensive report by IFPRI (Smith & Haddad, 2000) highlighted the importance of women's education in terms of influencing their nutritional choices as well as having an overall positive impact on child care. Previous studies (Abuya et al., 2012; Das et al., 2012) have shown that in poor urban areas, or slums, birth weight is a strong predictor of children's undernutrition, which is linked to intrauterine growth restriction (IUGR). Importantly,

Table 5.3 Sample size by country.

Country	n
Burkina Faso	3,243
Burundi	1,361
Congo (DRC)	3,575
Mozambique	3,608
Nepal	1,091
Niger	2,607
Rwanda	1,225
Senegal	3,645
Sierra Leone	1,920
Zambia	2,073
Total sample size:	24,348

low birth weight is positively associated with poor health outcomes in later life (Adair et al., 2013) and thus should regularly be incorporated in similar studies. In addition, following the analysis by Arokiasamy et al. (2012), mother's exposure to media was accounted for. It has been assumed that women with regular exposure to media have access greater access to information, which in turn can influence their behaviour. Given that this study uses Principal Component Analysis (PCA), all variables have been recoded so that the values of specific indicators follow the same logical direction. The description of the variables included in the PCA is provided in the next section.

5.6.2 Statistical methods

This study makes use of descriptive statistics, inequality measures and logistic regression. In addition, in order to derive inequality indicators, Principal Component Analysis is carried out. This section briefly discusses the application of PCA and inequality measures. As highlighted in section 3.5.2, PCA is a frequently applied data reduction technique. The resulting index is usually based on the first component, which represents the greatest proportion of variance explained. While traditionally PCA has been applied to continuous variables due to its normality assumption, many studies have extended the use of PCA to also include categorical and binary variables (Filmer & Pritchett, 1998; Rutstein & Johnson, 2004). This is particularly the case when asset-based indices are constructed. While ideally wealth indices should contain data on household expenditure, in the context of Demographic and Health Surveys, this information is not available.

A convenient alternative to creating a new Assets Index (AI) is to apply the existing wealth index provided by the DHS.[33] However, DHS wealth indices do not distinguish between urban and rural differences. In the context of the present study, this is important as the focus of this research is on intra-urban inequalities only. Thus, ownership of agricultural land, although an important factor, is likely to occur less frequently in urban settings. The selection of key indicators was therefore carried out for urban areas only and PCA was used to reduce the dimension of the data.

[33] It should be noted that while DHS wealth indices have been widely used (Kimuna & Djamba, 2005; Ndaruhuye et al., 2009; Singh et al., 2012), they have also received criticism because of their focus on material/durable goods. For example, Falkingham and Namazie (2002) highlighted that asset-based indices are not suitable for measuring absolute poverty nor for comparing poverty over time.

The variance explained by the first proportion of variance explained ranged from 31 to 42 per cent, depending on the country.[34] In addition, in order to overcome the limited focus of asset-based indices on households' goods, complementary factors have been considered. These included house material (roof, wall and floor) as well as parents' education. Regarding the latter, continuing variables measuring both mother's education and father's education have been included in an additional AI. As highlighted by Montgomery and Hewett (2005, p.405), "education is a type of long-lasting characteristic that produces a lifetime stream of income and consumption" and therefore it is useful to test for its potential impact.[35] The list of variables included in PCA is provided is Table 5.4.

The second set of quantitative methods used in this study involves inequality measures. Inequality measures traditionally applied in health research include ratios, coefficients of variation, GINI coefficients, Lorenz curves, Theil's T statistics and concentration curves/concentration indices. While a number of different inequality measures are used by social scientists, an influential study by Kawachi and Kennedy (1997) showed that in fact the choice of inequality measure had little influence on final results and that distinct inequality measures were correlated with each other. This study considers ratios, concentration indices and concentration curves as key inequality measures. In terms of computation, ratios can be said to be the most straightforward indicators, as they simply involve dividing the relevant variables in the highest and lowest distributions of the data. Traditionally, decile ratio and quintile ratios have been used to assess inequality (Lobmayer & Wilkinson, 2000; Gold et al., 2001; Singh et al., 2012). De Maio (2007) argued that ratios have an important advantage of allowing sensitivity analyses involving the comparison of correlation coefficients in the selected spectra of the data. On the other hand, the limitations of ratios include the fact that they discard the entire distribution of the data by focusing purely on the extreme ends of the distribution.

Regarding concentration curves, their key advantage is that, similarly to the Lorenz curves, they enable graphical representation of inequality patterns in a selected outcome variable. However,

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[34] More specifically, the proportion of variance explained by country was as follows: Burkina Faso – 35%, Burundi – 37%, DRC – 32%, Mozambique – 42%, Nepal – 34%, Niger – 34%, Rwanda – 32%, Senegal – 31%, Sierra Leone – 33%, Zambia – 35%.

[35] For all the countries, the proportion of variance explained remained almost identical to when education has not been accounted for.

contrarily to the Lorenz curves, concentration curves apply ranks by socio-economic status rather than by health variables (Carr-Hill & Chalmers-Dixon, 2005). While traditionally concentration.

Table 5.4 Variables used for the creation of the Assets Index.[36]

Variable	**scale**	**coding**
durable/material assets		
has electricity	binary	1 - no, 2-yes
toilet type	categorical	1 - no toilet, 2- shared other, 3-shared flush, 4-private other, 5-private flush
wall material	categorical	1 - natural, 2 - rudimentary, 3 - finished
roof material	categorical	1 - natural, 2 - rudimentary, 3 - finished
floor material	categorical	1 - natural, 2 - rudimentary, 3 - finished
has radio	binary	1 - no, 2-yes
has television	binary	1 - no, 2-yes
has refrigerator	binary	1 - no, 2-yes
has motorcycle/ scooter	binary	1 - no, 2-yes
has car/track	binary	1 - no, 2-yes
parents' educational capital		
mother's education	categorical	1 - no education, 2 - incomplete primary, 3 - complete primary, 4- incomplete secondary, 5-complete secondary, 6- higher
father's education	categorical	1 - no education, 2 - incomplete primary, 3 - complete primary, 4- incomplete secondary, 5-complete secondary, 6- higher

[36] The details of distribution for each variable by country included in the index can be found in Appendix L.

curves have been used for continuous variables, increasingly equivalent calculations can be computed for binary data based on the relevant proportions. In a perfectly equal society the concentration curve would be a 45-degree line. On the other hand, the greater the distance between the 45-degree "equality line" and the concentration curve, the larger the health inequalities

The concentration index (CI) is based on the corresponding curve. While concentration curves allow us to easily observe the inequality patterns, concentration indices have the advantage of providing a single indicator, which can be compared across time and different groups. The concentration index is defined as two times the area between the equality line and the concentration curve (O'Donnell et al., 2008). The values of the concentration index fall between -1 and 1, with O indicating perfect equality. When health variables measure ill health, a negative sign of a concentration index indicates greater concentration of the outcome amongst the disadvantaged groups (Wagstaff, 2000; O'Donnell et al., 2008). For the binary variables the concentration index can be mathematically defined in the following way:

$$C = \frac{2}{n\mu} \sum_{i=1}^{n} y_i R_i - 1$$

where μ is the mean of the binary variable, *n* is the sample size and *R* is the rank of the socio-economic status. It results from the above that the value of the concentration index is influenced by the relationship between the outcome (health) variable and the rank of the welfare variable, rather than the distribution of the latter. The value of the CI indicates the strength and direction of inequalities, with larger absolute values involving greater inequalities. As highlighted in the previous section, in the context of the present study, the binary outcome variables include underweight (weight for age Z-score) and stunting (height for age Z-score). The rank of the socio-economic variable is based on the Assets Index constructed by the author.

Finally, the analysis is complemented by conducting a logistic regression analysis. As highlighted in Chapter 4, logistic regression modelling is widely used in estimating health outcomes when response variables are binary. Previous research (Griffiths et al., 2004; Pongou et al., 2006) highlighted that household effects are an important factor affecting child undernutrition. Similarly, existing scholarly analysis investigating urban health stressed that substantial grounds existed to examine community or neighbourhood effects (Montgomery & Hewett, 2005). Multilevel models were therefore fitted in order to test for both household and community effects. The potential impact of neighbourhoods was based on cluster variables available in DHS datasets. The approach of using the sampling cluster as an approximation for communities has been applied extensively in previous research (da Costa Leite et al., 2004; Montgomery & Hewett, 2005). As highlighted by da Costa Leite et al. (2004, p.687) , "a cluster can be considered a proxy for neighbourhood or community, and reflects local service environment as well as local culture". The results of the analysis are presented in the next section.

5.7 Results

5.7.1 Descriptive statistics and inequality measures

Tables 5.5-5.7 summarise the results of descriptive analysis as well as key inequality measures. Based on the results presented in Table 5.5, it can be deducted that, overall, most rapidly urbanising countries experience greater intra-urban inequalities when compared to less rapidly urbanising nations. Thus, for example, when considering child underweight, it can be noticed that in the most rapidly urbanising countries group, amongst the poorest households 21.7 per cent of children suffer from underweight. While this is comparable to equivalent proportions in the less rapidly urbanising countries, the percentages of underweight children amongst the richest households differ, thus revealing more severe inequalities in most rapidly urbanised countries. More specifically, around 6.4 per cent of children from the richest households are underweight in the most rapidly urbanising LDCs as compared to 9.6 per cent in less rapidly urbanising countries. When considering child stunting, the patterns are similar. In line with official sources (UNICEF, 2013), country-level proportions of stunted children are higher when compared to proportions of children suffering from underweight. In the most rapidly urbanising nations, amongst the children in the poorest households, almost 44 per cent children are stunted and this number declines to 15 per cent for children in the richest households. On the other hand, in the less rapidly urbanised nations, 40 per cent of children from the poorest households are stunted as compared to 19 per cent of those living in the richest households. Based on the results of the χ^2 test, the differences between cells in the cross-tabulations (Table 5.5) are statistically significant ($p<0.01$).

Further conclusions can be drawn when analysing selected inequality measures (Tables 5.6 & 5.7). Quintile proportions ratios confirm existing wealth-related inequalities. While at the country group level most rapidly urbanising countries show greater intra-urban inequalities, discrepancies between individual countries exist. Thus, at the pooled data level, the ratio of child undernutrition of poorest to richest households is almost 3 for stunting, and approximately 3.4 for underweight. At the individual country level, the equivalent ratios vary with the largest inequalities observed in Burundi, Mozambique and Nepal. For example, in Burundi, the child stunting ratio is 4.2, while the child underweight ratio is as high as 6.5. Importantly, when the assets index is constructed by including parents' education, the inequalities are wider. For the pooled data, in the most rapidly urbanising countries, the ratios increase from 3.0 to 3.4 for child stunting and from 3.4 to 3.8 for child underweight.

Concentration curves and concentration indices confirm previous observations and allow more nuanced conclusions. As highlighted in section 5.6.2, the lower the value of concentration indices, the higher the existing inequalities. The results presented in Tables 5.6 and 5.7 show that overall most rapidly urbanising countries experience greater intra-urban inequalities. In this group of countries, based on the quintile distribution of undernutrition variables constructed using households' material assets only, the concentration indices are -0.20 for child stunting and -0.23 for child underweight. The values of these indices are smaller (indicating greater disparities) when parents' education is added to households' durable assets. For all countries but Rwanda, inequalities are greater in child underweight than in child stunting. In particular, Burundi and Mozambique experience very severe intra-urban disparities in child underweight with concentration indices equal to or exceeding -0.3. Comparatively, in the less rapidly urbanising countries, the intensity of inequalities is less pronounced. At the pooled data level, the values of all concentration indices fall between -0.13 and -0.17 for underweight and between -0.14 and -0.16 for stunting. As with the previous country group, inequalities are slightly greater when accounting for parents' education. Figures 5.4 through 5.7 provide a graphical illustration of the above-discussed inequality patterns.

Finally, unadjusted logistic regression analysis was conducted in order to examine the extent of inequalities between the top and bottom quintiles of wealth distribution. The analysis was run controlling for intermediate wealth quintiles (poorer, middle and richer). For the most rapidly urbanising LDCs, the odds ratio for stunting is 0.22, while the odds ratio for underweight is 0.25,

Table 5.5 Descriptive statistics (most rapidly and less rapidly urbanising LDCs).

	Most rapidly urbanising LDCs						**Less rapidly urbanising LDCs**					
	Households wealth						Households wealth					
Child underweight	poorest	poorer	middle	richer	richest	Total	poorest	poorer	middle	richer	richest	Total
not underweight (frequency)	940	946	1,055	1,107	1,037	5,085	796	946	895	903	972	4,512
%	78.27	85.46	87.84	91.49	93.59	87.27	77.81	80.79	81.96	84.39	90.42	83.08
underweight (frequency)	261	161	146	103	71	742	227	225	197	167	103	919
%	21.73	14.54	12.16	8.51	6.41	12.73	22.19	19.21	18.04	15.61	9.58	16.92
Total	1,201	1,107	1,201	1,210	1,108	5,827	1,023	1,171	1,092	1,071	1,075	5,431
%	100	100	100	100	100	100	100	100	100	100	100	100
Pearson χ^2	χ^2=150, p<0.01						χ^2=68, p<0.01					
Child stunting												
not stunted (frequency)	672	694	850	948	944	4,108	610	720	731	811	866	3,738
%	56.05	62.69	70.83	78.54	85.2	70.57	59.69	61.54	67.00	75.94	80.63	68.90
stunted (frequency)	527	413	350	259	164	1,713	412	450	360	257	208	1,687
%	43.95	37.31	29.17	21.46	14.8	29.43	40.31	38.46	33.00	24.06	19.37	31.10
Total	1,199	1,107	1,200	1,207	1,108	5,821	1,022	1,170	1,091	1,068	1,074	5,425
%	100	100	100	100	100	100	100	100	100	100	100	100
Pearson χ^2	χ^2 = 306, p<0.01						χ^2 = 166, p<0.01					

Table 5.6 Summary of selected inequality measures (most rapidly urbanising countries).

Indicator of undernutrition	Selected inequality measures	Study countries & aggregate dataset						
		Burkina Faso	**Burundi**	**Mozambique**	**Nepal**	**Rwanda**	**5 LDCs**	**5 LDCs (2)**
stunting	quintile ratio (poorest to richest)	1.68	4.15	3.24	3.74	3.76	**2.97**	**3.42**
	concentration index	-0.13	-0.27	-0.20	-0.21	-0.26	**-0.20**	**-0.22**
	logistic regression OR (richest compared to poorest)	0.51 (10)***	0.12 (0.04)***	0.19 (0.03)***	0.16 (0.06)***	0.17 (0.07)***	**0.22 (0.02)***	**0.19 (0.02)***
underweight	quintile ratio (poorest to richest)	2.22	6.49	6.84	3.33	1.92	**3.39**	**3.76**
	concentration index	-0.15	-0.36	-0.30	-0.24	-0.17	**-0.23**	**-0.24**
	logistic regression OR (richest compared to poorest)	0.38 (0.09)***	0.11 (0.05)***	0.12 (0.04)***	0.21 (0.08)***	0.49 (0.28)	**0.25 (0.03)***	**0.22 (0.03)***

Note: the results in last column (**5 LDCs**[2]) have been computed based on the modified assets index, which also included parents' intellectual characteristics.
*** denotes highly significant (p<0.01). Logistic regression controls for intermediate wealth groups.

Table 5.7 Summary of selected inequality measures (less rapidly urbanising countries).

Indicator of undernutrition	Selected inequality measures	Study countries & aggregate dataset						
		Congo (DRC)	**Niger**	**Senegal**	**Sierra Leone**	**Zambia**	**5 LDCs**	**5 LDCs (2)**
stunting	quintile ratio (poorest to richest)	2.50	2.49	2.44	1.42	1.92	**2.13**	**2.39**
	concentration index	-0.17	-0.17	-0.15	-0.09	-0.12	**-0.14**	**-0.16**
	logistic regression OR (richest compared to poorest)	0.26 (0.06)***	0.29 (0.07)***	0.33 (0.09)***	0.63 (0.19)	0.36 (0.06)***	**0.36 (0.00)*** **	**0.29 (0.00)*** **
underweight	quintile ratio (poorest to richest)	2.18	2.64	1.69	2.51	2.58	**2.32**	**2.84**
	concentration index	-0.12	-0.17	-0.08	-0.12	-0.16	**-0.13**	**-0.17**
	logistic regression OR (richest compared to poorest)	0.40 (0.11)***	0.29 (0.07)***	0.55 (0.18)*	0.33 (0.12)***	0.35 (0.09)***	**0.37 (0.00)*** **	**0.29 (0.00)*** **

Note: the results in last column (**5 LDCs^2**) have been computed based on the modified assets index, which also included parents' intellectual characteristics. *** denotes highly significant (p<0.01). Logistic regression controls for intermediate wealth groups.

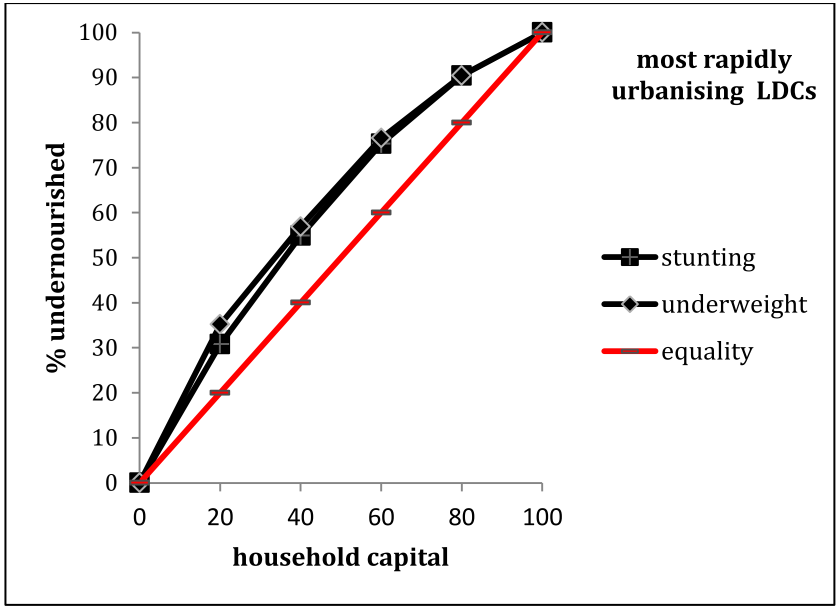

Figure 5.4 Intra-urban inequalities in child nutritional outcomes in the most rapidly urbanising LDCs.

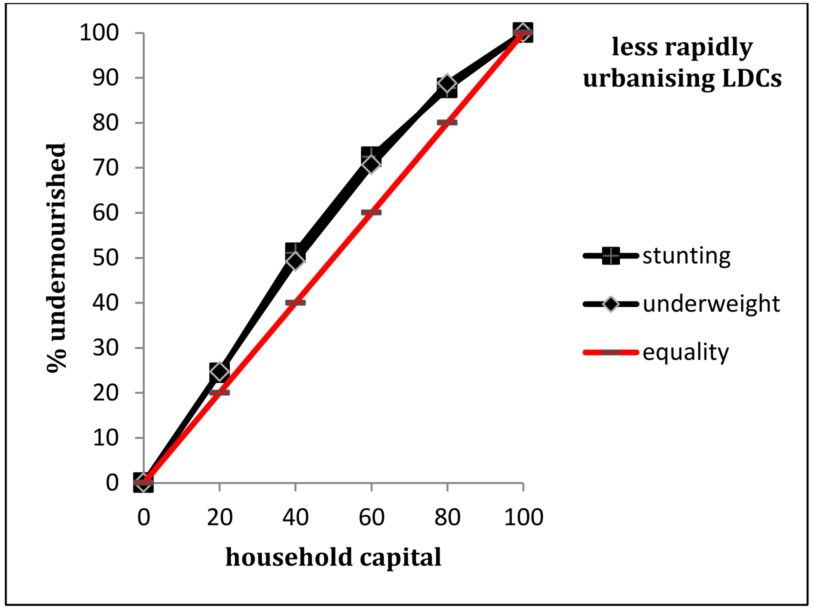

Figure 5.5 Intra-urban inequalities in child nutritional outcomes in the less rapidly urbanising LDCs.

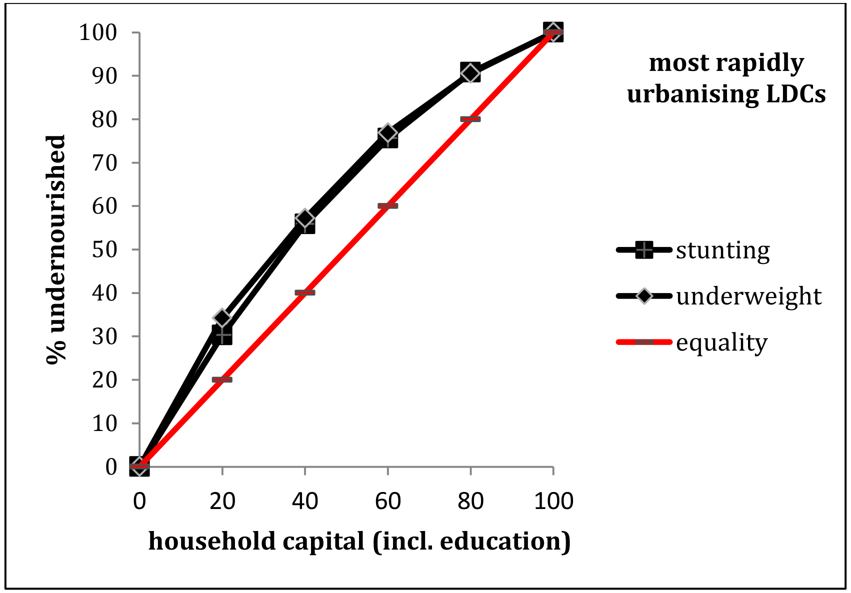

Figure 5.6 Intra-urban inequalities in child nutritional outcomes in the most rapidly urbanising LDCs (accounting for parents' education).

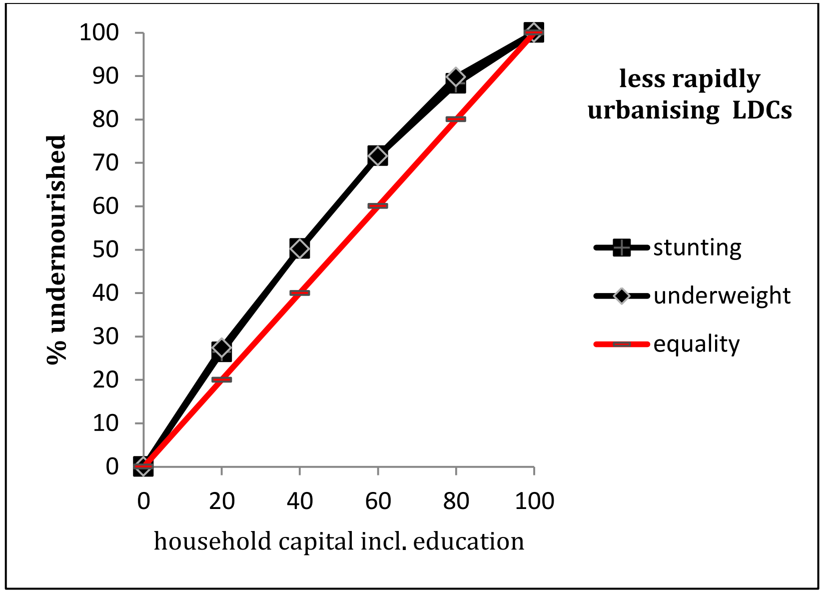

Figure 5.7 Intra-urban inequalities in the less rapidly urbanising LDCs (accounting for parents' education).

indicating that children in the richest households are significantly more likely not to suffer from undernutrition as compared to children from poorer households. When parents' education is included in the households' assets index, as previously, the severity of inequalities intensifies. On the other hand, in the less rapidly urbanising LDCs, the equivalent odds ratios fall in the range of 0.36 to 0.37, and follow the previous patterns, where education exacerbates intra-urban inequalities. Based on the results of the regression analysis, the largest inequalities in child stunting can be observed in Burundi and Nepal, while the greatest inequalities in child underweight are reported for Burundi and Mozambique.

5.7.2 Logistic regression analysis

The aim of the logistic regression analysis is to incorporate controlling variables and evaluate to what extent they influence child undernutrition in the context of rapid pace of urbanisation. Following on the primary research question (section 5.1), the models test the extent of wealth-based intra-urban inequalities in children's nutritional outcomes in most and less rapidly urbanising LDCs. The models control for additional socio-economic characteristics, as discussed in the methods section. Table 5.8 provides summary results of the logistic regression for child underweight as outcome variable. For comparison, the outcome of regression analysis with child stunting as dependent variable is provided in Appendix O.

Based on the results of the regression modelling (Table 5.8), it can be concluded that, controlling for other key factors, such as mother's socio-economic attributes and child's background characteristics, children in the poorest households are at a significant disadvantage when it comes to their nutritional status. This impact is greater in the most rapidly urbanising countries, where all wealth groups are statistically significant at least at 1 per cent significance level. When compared with the children from the poorest households, *ceteris paribus*, children from the richest households are 73 per cent less likely to suffer from underweight. Comparatively, in the less rapidly urbanising LDCs, children from the wealthiest households are around 45 per cent less likely to be underweight. In the less rapidly urbanising LDCs, intermediary household wealth quintiles lose their statistical significance when controlling for other confounding factors.

Table 5.8 Results of final logistic regression models.

Child underweight	**Most rapidly urbanising LDCs**	**Less rapidly urbanising LDCs**
Variable	OR (CI)	OR (CI)
Household assets		
Poorer	0.65 (0.50; 0.86)***	0.94 (0.70; 1.26)
Middle	0.58 (0.44; 0.78)***	0.86 (0.64; 1.17)
Richer	0.40 (0.29; 0.56)***	0.84 (0.62; 1.16)
Richest	0.27 (0.18; 0.39)***	0.55 (0.39; 0.79)***
Baseline: poorest	1.00	1.00
Number of household members		
6-10	0.96 (0.78; 1.17)	0.96 (0.78; 1.19)
more than 10	1.48 (1.05; 2.08)**	1.22 (0.93; 1.60)
Baseline: 1-5	1.00	1.00
Mother's socio-educational characteristics		
Years of education	0.92 (0.90; 0.94)***	0.91 (0.89; 0.94)***
Mother works	0.90 (0.73; 1.10)	0.95 (0.80; 1.15)
Baseline: mother doesn't work	1.00	1.00
Regular exposure to media	1.00 (0.80; 1.25)	0.90 (0.72; 1.12)
Baseline: no regular exposure to media	1.00	1.00
Child's characteristics		
Child is a girl	0.83 (0.68; 1.00)**	0.85 (0.71; 1.01)*
Baseline: child is a boy	1.00	1.00
Low birth weight	3.34 (2.64; 4.23)***	2.66 (2.05; 3.45)***
Baseline: Normal birth weight	1.00	1.00
Country dummy		
Burundi	0.98 (2.64; 4.23)	
Mozambique	0.40 (2.64; 4.23)***	
Nepal	1.13 (2.64; 4.23)	
Rwanda	0.29 (2.64; 4.23)***	
DRC		1.43 (1.10; 1.86)***
Senegal		0.58 (0.41; 0.82)***
Sierra Leone		0.98 (0.66; 1.45)
Niger		1.22 (0.89; 1.67)
Constant	0.44 (0.32; 0.62)***	0.33 (0.23; 0.48)***
Community-level variance	0.19 (0.08; 0.43)**	0.13 (0.05; 0.33)**
Log likelihood	-1,585	-1,670
number of observations	4,841	4,214

Notes: *** denotes p<0.01, ** denotes p<0.05, * denotes p<0.1, OR stands for Odds Ratio and CI stands for 95 % Confidence Intervals.

The results of the regression modelling presented in this section confirm the importance of mother's education (measured as years of schooling), while showing statistical insignificance of mother's working status and exposure to media. Thus, in both most rapidly urbanising and less rapidly urbanising LDCs, when controlling for confounding factors, an additional year of mother's education decreases the odds of a child being underweight by 8 to 9 per cent. Surprisingly, mother's working status is not statistically significant, even if no other explanatory variables are accounted for. This might be explained by the fact that women often receive very modest remuneration for their work, which does not allow them to purchase quality nutrition. At the same time, female work implies spending time outside of their households, which can also have a negative impact on child care. Similarly, regular media exposure is not a statistically significant factor when considered together with other explanatory variables included in this analysis. However, when regular media exposure is used as the only predictor of child underweight it becomes highly significant in both most rapidly and less rapidly urbanising LDCs ($p<0.01$). It can be assumed that regular media exposure constitutes a valuable source of information and thus is likely to influence mother's behaviour, also in terms of nutritional habits.

Finally, child characteristics, such as child birth weight and child sex, have a mixed effect on the likelihood of child underweight. Child birth weight stands out as a strongly significant predictor of underweight in both country groupings. The strength of these associations is greater in the most rapidly urbanising LDCs with ($OR = 3.34$, $p<0.01$), implying that children born with a low birth weight are more than 3.3 times more likely to suffer from underweight as compared to children who were born with normal weight. The association is also strong in the less rapidly urbanising countries ($OR=2.66$, $p<0.01$). Regarding child gender, male children seem to be more at a disadvantage when it comes to their nutritional outcomes, although the association is only significant at 10 per cent significance level in the less rapidly urbanising countries. When looking at the regression results with stunting as the outcome variable (Table O.1.), the association is highly significant in both country groupings ($p<0.01$). This confirms the results of previous research which concluded that boys in the LDCs are more at risk of stunting (Svedberg, 1990; Wamani et al., 2007) and that this trend is also prevalent in the poorest households. Thus, while the investments in girls' and women's empowerment remain an important development factor, these should not overshadow a need for a balanced gender approach.

Lastly, all models considered both country and community effects. Based on the results presented in Table 5.8, it can be noted that, controlling for other factors, Senegal, Mozambique and Rwanda show a negative effect on child underweight, while DRC is positively associated with child underweight. At the same time, community effects proved to be statistically significant, indicating that policy measures should include neighbourhood-specific initiatives.

5.8 Discussion and conclusions

Drawing from the post-Malthusian literature and developmental studies, this research aimed at estimating the extent of intra-urban inequalities in child undernutrition in the context of rapid urbanisation. More specifically, the first objective of this chapter was to investigate whether these inequalities are greater in the group of LDCs that have experienced most rapid urbanisation. The findings of the present study allowed confirming this hypothesis. Descriptive statistics and inequality measures as well as the results of logistic regression modelling showed that, even when controlling for confounding factors, the scale of intra-urban inequalities in child undernutrition is greater in most rapidly urbanising LDCs as compared to those countries that have experienced less rapid pace of urbanisation. Moreover, these inequalities are exacerbated by parents' educational capital. Further study aims were to examine the contribution of mother's socio-educational background and children's attributes on children's nutritional status. In both LDC groups (most rapidly and less rapidly urbanising countries), mother's education played a strongly significant role in reducing child undernutrition. At the same time, child's birth weight was proved to be a strong and statistically significant predictor of child undernutrition. Overall, male children were found to be more disadvantaged in terms of suffering from undernutrition, which was the case in both country groupings. A summary of hypotheses and findings is presented in Table 5.9.

The results of the present study are largely in line with existing literature on intra-urban inequalities (Menon et al., 2000; Fotso, 2006; Van de Poel et al., 2007; Arokiasamy et al., 2012), although no direct comparison can be made due to limited literature on the subject. Fotso's results showed the greatest intra-urban inequalities for Mozambique and Tanzania, while the narrowest inequalities are reported in Zambia and Chad (Fotso, 2006). Similarly,

Table 5.9 Comparison of predictions and findings.

Hypothesis	Result	Comment
Intra-urban inequalities in nutritional outcomes amongst children are greater in those least developed countries which have been experiencing most rapid urbanisation.	H_0 has been rejected	Children in the most rapidly urbanising countries suffer from greater intra-urban inequalities in nutritional outcomes.
Parents' education has a modifying effect on the extent of intra-urban inequalities in nutritional outcomes in the LDCs.	H_0 has been rejected	Poor education of the parents exacerbates existing (wealth related) intra-urban inequalities.
Mother's socio-educational background is associated with children's undernutrition in the LDCs.	H_0 has been rejected	Mother's education has a strong negative effect on child's risk of undernutrition.
Low birth weight increases the risk of child undernutrition in the LDCs.	H_0 has been rejected	Children with low birth weight are significantly more likely to be underweight or stunted as compared to children with normal birth weight.

Menon et al. (2000) found that amongst the 11 analysed countries Zambia had the lowest intra-urban inequality of child stunting. This is in line with the argumentation and findings in the present chapter, as both Mozambique and Tanzania have undergone a very rapid pace of urbanisation, while Zambia and Chad are amongst the less rapidly urbanising countries. The study by van de Poel at al. (2007) is more difficult to relate to because its scope is global, thus encompassing different developmental and geographical regions. The authors, however, concluded that countries experiencing a very slow pace of urbanisation, such as Armenia or Central Asian countries, have lower values in their respective concentration indices. On the other hand, countries from sub-Saharan Africa, as well as South Asia, suffer from much larger intra-urban inequalities in child stunting.

With regard to mother's socio-educational characteristics, the results are largely in line with findings by other scholars. For example, an extensive report by IFPRI (Smith & Haddad, 2000) highlighted the importance of women's education in terms of influencing their nutritional choices as well as having an overall positive impact on child care. More recently, Arokiasamy el al. (2012) found that, in India, mother's education had a highly significant effect on the risk of child undernutrition. The decomposition analysis conducted by the authors showed that, after household wealth, mother's education was the second greatest contributor to both child stunting and child underweight. Concerning child's birth weight, previous studies (Abuya et al., 2012; Das et al., 2012) have shown that in poor urban areas, or slums, birth weight is a strong predictor of children's undernutrition, which is linked to intrauterine growth restriction (IUGR). Finally, as far as child's gender is concerned, as mentioned previously, researchers (Svedberg, 1990; Wamani et al., 2007) found that boys were more likely to be at risk of stunting, which was also the result of the present study. In addition, another body of literature investigating inequalities in child health outcomes in Brazil found that boys were at significantly higher risk of poor health and hospitalisation (Hermeto & Caetano, 2009).

In addition to the empirical contribution of this research, this study provides a conceptual contribution and has important policy implications. As was also the case in Chapter 3 and Chapter 4, the questions in this study have been motivated by the Malthusian debate regarding inequalities as well as contemporary challenges in guaranteeing the right of survival for all. In terms of the conceptual contribution, the chapter proposed an interdisciplinary conceptual framework (section 5.3) which incorporated the multifaceted nature of inequalities. In this respect, previous interdisciplinary analytical frameworks, such as the development theory framework suggested by Ester Boserup (1996), provided inspiration. It is the author's conviction that, in order to enable adaptation of holistic approaches, the contemporary demographic research should borrow to a greater extent from other scientific disciplines, in particular economics, geography and developmental studies.

It should be acknowledged that, despite its contributions, this study has several limitations. The first limitation is linked to the quantitative assumptions as pertaining to the choice of countries. While utmost scrutiny has been applied in order to select the most rapidly and least rapidly urbanising LDCs, given the availability of different indicators and their variability over time, ultimately, no perfect combination of countries is likely to exist. Furthermore, as discussed in section 5.5, the choice of study countries had to be restricted to those nations where recent DHS data exist. The second limitation of this research is related to the fact that, while community effects are often approximated by sampling clusters (da Costa Leite et al., 2004; Montgomery & Hewett, 2005), in some countries or regions no perfect overlap between the two may exist. In addition, future studies could consider community-level variables as control factors. Furthermore, qualitative research is likely to yield interesting complementary results, in particular by shedding light on mothers' or parents' perspectives as well as analysing policy-makers' views.

This research has several important policy implications which should be considered within the broader post-MDG agenda. Current MDGs already target challenges such as global hunger, gender equality and environmental sustainability. Yet, while the Millennium Development Goals focus on the outcome indicators, such as improvement of living conditions of slum dwellers (MDG 7, objective 4), they neglect the macro-level processes which influence these outcomes. Moreover, these macro-level phenomena, such as rapid urban growth have far-reaching consequences in terms of individuals' livelihood strategies and their vulnerabilities to poverty and ill health. As shown in this study, uncoordinated urbanisation can lead not only to greater spatial differentials, but exacerbates existing inequalities in children's nutritional status. In this context, narrowing the severity of the intra-urban inequalities in child undernutrition requires a committed policy agenda focusing on pro-poor initiatives. Such an agenda should incorporate factors related to macro-level urban planning, rural development and investing in spatial connectivity. Importantly, because child undernutrition is part of the food insecurity challenge, agricultural policies, water management and public health promotion should constitute key factors of an integrated policy agenda.

As highlighted in previous studies (McGuire & Popkin, 1990; Summers, 1994; Cartwright et al., 2003; Buvinić, 2008), investments in women's education and maternal health constitute a pre-requisite for progress in human development. Continuous scaling up of investments in these areas should go beyond project-based interventions and be embedded in national plans concerning health systems, national educational systems, as well as policies promoting technology and innovation. Similarly, while gender equality is listed amongst the current MDGs (MDG 3), a balanced gender approach should go beyond women empowerment and target the most vulnerable populations. In the case of child undernutrition, as shown by this research, boys in the LDCs can be more vulnerable to stunting and underweight than girls. Finally, despite the focus of the current post-MDG thinking on individual well-being (Pritchett & Kenny, 2013; United Nations, 2013b), eradicating the underlying challenges pertaining to human survival, such a universal access to food and water, should be a pre-requisite for other developmental initiatives. While child survival is embedded in the UN Convention on the Rights of the Child (1989), formal M&E and legal mechanisms are required in order to ensure that this right is being respected. Because of the importance of the topic pertaining to the practical implications of rapid urbanisation on children's health outcomes, it is crucial to invest both time and funding in a comprehensive research strategy in this area of study.

CHAPTER 6 CONCLUSIONS

"The wealth and power of nations are, after all, only desirable as they contribute to happiness" (Malthus, 1826, p.391).

6.1 Summary of empirical findings and contributions

This thesis has been motivated by the observations from 1) the traditional Malthusian theory and post-Malthusian debate regarding the presupposed impact of population growth on the availability of resources and 2) the contemporary developmental challenges pertaining to food security and access to safe drinking water in the context of rapid urbanisation. The Malthusian theory has provided an inspiration for a vast body of research beyond demographic studies. At the same time, as highlighted in Chapter 1, a research gap has been identified with regard to the role of contemporary urbanisation and the underlying urban processes when it comes to conceptualising the key factors affecting the availability of and access to vital resources, such as food and water. Given the rapidity and scope of present-day urbanisation and the effect that urban growth can have on household survival and well-being, the findings of this thesis are intended to contribute not only to academic debate but also to the ongoing policy agenda. The thesis is particularly timely in low- and middle-income countries where the scale of urbanisation and unruly development constitute a critical policy challenge for planners and programme managers. Moreover, there is considerable shift in occupational skills and human capital, which accelerates rural-urban migration. The relationship between urbanisation processes and access to essential resources, such as food and water, needs to be better understood.

Given the broad scope of this research, the present study concerned itself with three primary research areas presented in Chapter 1, which were then operationalised by specific research questions and hypotheses outlined in each empirical chapter (Chapters 3-5). To recapitulate, the overarching research questions were as follows:

- **RQ1:** What is the impact of urbanisation on the access to and availability of vital resources at the macro and micro level?

- **RQ2:** How does human capital influence the effect of urban factors on access to vital resources?

- **RQ3**: What is the extent of intra-urban inequalities in access to basic means of subsistence?

In addition to operationalising the above questions, each chapter aimed to address a distinct research problem identified in the Malthusian literature and post-Malthusian studies. Thus, the primary motivation for Chapter 3 was the continuing debate regarding the potential impact of population growth on food supplies in times when the majority of the human population resides in urban areas, and when the effects of urban growth can have important consequences on households' livelihoods. The main argument in that chapter was that the population growth-hunger debate is simplistic for at least two reasons. First, it ignores the fact that urbanisation can directly affect the distribution of food and access to food, which can have broader indirect impacts on populations' capabilities and endowments. Second, such an approach neglects the evolving nature of contemporary food insecurity challenges, which encompass food insecurity risk factors and adverse nutritional outcomes. In this context, the primary goal of Chapter 3 was to investigate the macro-level relationship between urban growth and food insecurity. Additional investigation focused on the mitigating effect of human development on this association (measured in terms of the level of development) and direct impact of globalisation, disasters and geographical habitat. Following the recommendations made by Williams (2009, 2010), the analysis was conducted by fitting heterogeneous choice models.

Specifically, the results of Chapter 3 have shown that, at the country level, urban growth is positively associated with food insecurity risk. For a one-unit increase in urban growth rate, the odds of being in the high food insecurity risk group versus the low- and middle-risk categories are multiplied by over 2.1. This impact varies depending on countries' level of development; the probability of a high food insecurity risk linked to urban growth is much higher in the developing countries group. Readers might critique this result by referring to slow urban growth in the developed world. It should, however, be stated that, while overall developing countries are experiencing more rapid urbanisation, at the same time many countries in the category of high development continue to undergo rapid urban growth. In addition, the interaction effect remains significant when only the developing countries group (countries with medium development and low development levels) is considered. Importantly, the analysis showed that the impact of urbanisation is attenuated by countries' education, which highlights the key role of human capital. Finally, the results confirmed a differentiated effect of globalisation on food security, a significant impact of geographical habitat on food insecurity, and a positive association between population stock and the food insecurity risk. The proponents of Malthus should, however, note that the significance of the relationship between TFR and food insecurity risk varied depending on confounding factors included in the models. Key findings of the research conducted in this thesis are summarised in Box 6.1.

Methodologically, Chapter 3 suggested a new food insecurity risk index (FIRI) based on the official FAO indicators of food insecurity. With regard to its conceptual contribution, the chapter proposed reorienting the traditional population growth-food debate by suggesting a simple conceptual framework incorporating key contemporary elements affecting food insecurity risk, with a focus on urbanisation. Secondly, Chapter 3 offered a revised interpretation of FAO's food security and food insecurity definitions by accounting for contemporary challenges related to access, availability, stability and utilisation of food. The summary of key definitions used in the thesis is provided in Box 6.2.

The arguments in Chapter 4 have primarily been motivated by the work of Julian Simon (1977; 1981), Ester Boserup (1976; 1981; 1987, 1993) and Thomas Homer-Dixon (1995). The chapter developed an argument that, in the era of rapid urbanisation and increasing urban poverty, human capital can act as an attenuating factor with regard to households' access to safe drinking water. The results of the analysis in Chapter 4 showed that, while urban residence continues to be positively associated with access to safe drinking water, strong within urban-differentials exist, with city dwellers having the greatest probability of water access. In addition, it has been found that macro-level rate of urban growth and proportion of urban population in slums have a significant negative impact on households' access to safe drinking water. Regardless of the indicator used to measure urbanisation, households' human capital was proved to have a significant mitigating effect on the

Box 6.1 Summary of key findings

Chapter 3

- Urban growth has a negative effect on food security. For one per cent increase in the rate of urban growth, the odds of falling into the high food insecurity group of countries versus the combined medium and low food insecurity categories are 2.14 times greater (model 1, Table 3.5).

- Countries' level of development influences the association between urbanisation and food insecurity risk.

- Education has a mitigating effect on the association between urbanisation and food security. Countries with higher levels of education have greater probability of having low risk of food insecurity.

- TFR is positively associated with high food insecurity risk. *Ceteris paribus*, an increase of one child per woman increases the odds of being in the high food insecurity risk category of countries versus the combined medium and low food insecurity categories by 22 per cent (model 5, Table 3.5).

- Internet usage is negatively associated with high food insecurity risk. One per cent increase in the proportion of internet users in the country decreases the odds of being in the high food insecurity risk category of countries versus the combined medium and low food insecurity categories by 2 per cent, given that the other variables in the model are held constant (model 3, Table 3.5).

- Number of disasters in a country is positively associated with high food insecurity risk.

- Countries with a high proportion of agricultural land (above median) are less likely to be in the high food insecurity risk category of countries.

Chapter 4

- There exists a significant positive association between urban residence and access to SWD. The strength of this association further varies depending on the specific type of urban residence.

- Households in large cities are significantly more likely to have access to SDW as compared to households in the countryside (model 3, Table 4.7).

- Macro-level urban growth has a negative impact on households' access to safe drinking water.

- Human capital has mitigating influence in explaining the association between urban residence and access to SDW.
- Human capital has a mitigating effect on the relationship between the macro-level rate of urban growth and household water access.
- *Ceteris paribus*, households with a female head of household are around 20 per cent more likely to have access to SDW as compared to households with a male head of household (model 4, Table 4.7 & model 6, Table 4.8).
- Larger households are more likely to have access to SDW.

Chapter 5

- On average, the extent of inequalities is larger in the LDCs which have undergone most rapid pace of urbanisation. Children in the most rapidly urbanising countries suffer from greater intra-urban inequalities in nutritional outcomes; however, differences exist between individual countries.
- Poor education of the parents exacerbates existing (wealth-related) intra-urban inequalities.
- Mother's education has a strong negative effect on child's risk of undernutrition. One year increase in mother's education decreases the odds of a child being underweight by 8 to 9 per cent , given that other variables in the model are held constant (Table 5.8).
- Mother's working status does not have a significant effect on child's risk of being underweight or stunted.
- Children with low birth weight are significantly more likely to be underweight or stunted as compared to children with normal birth weight.
- Boys are more likely than girls to be underweight and stunted. This effect is greater for stunting; *ceteris paribus* boys are 25-26 per cent more likely to be stunted than girls (Table O.1).
- There are significant community affects which impact children's nutritional outcomes.
- Results suggest the need to focus on strategic urban planning and account for macro-level urban processes, which are likely to exacerbate the existing wealth-related inequalities in the LDCs.

Box 6.2 Summary of key concepts developed and applied in the thesis.

Contemporary preventive and positive checks

Following on from the Malthusian definition, contemporary "preventive checks" act at the fertility level. They encompass the impact of the positive aspects of urbanisation, referred to as "urban advantage". On the other hand, "positive checks" operate at the mortality level and include detrimental effects of urbanisation, such as lower life expectancy caused by deaths attributed to pollution and other urban hazards.

Food security & food insecurity

Based on FAO's definition, food security is defined as "a situation that exists when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life" (FAO et al., 2013, p.50). Conversely, food insecurity is defined as a "situation that exists when people lack secure access to sufficient amounts of safe and nutritious food for normal growth and development and an active and healthy life" (FAO et al., 2013, p.50). The four aspects of food security are: availability, access (physical and financial), utilisation and stability. While the present study conforms to the above definitions, it postulates that a novel approach is required regarding the interpretation and measurement of both concepts.

Human capital

Individual human capital is defined as one's capacity to innovate, or generate new ideas; and translate these new ideas into practice. This definition assumes that the process of innovation is stimulated by acquisition of knowledge through the process of education. At the macro-level, accumulation of human capital enables countries' technological advancement and facilitates overall developmental progress. The definition assumes that human capital is a key factor contributing to closing the ingenuity gap (Homer-Dixon, 1995).

Inequalities

Drawing on the WHO (2013) definition of health inequalities, inequalities are defined as differences in health, economic and educational outcomes as well as departures in the distribution of key determinants affecting these outcomes. The nature of inequalities can incorporate socio-economic, spatial and demographic factors and can operate at different levels of analysis. Inasmuch, investigating inequalities requires a comprehensive multidisciplinary approach.

Urbanisation

Drawing on the definitions developed by Davis (1955) and international agencies (UN, 2011b; OECD, 2012a), urbanisation is defined as a process of population concentration, which has important demographic, social and environmental ramifications. By including the impact of the urbanisation in its definition, this concept highlights the multifaceted and multi-disciplinary nature of urbanisation.

association between urbanisation and water access. In addition, households with a female head of household were found to be more likely to benefit from water access as compared to the households with a male head of household. As expected, households' distance to a water source had a significant positive effect on access to safe drinking water. On the other hand, contrary to the Malthusian perspective, the number of household members was negatively associated with water access. Conceptually, Chapter 4 contributed to the existing body of literature by proposing a new analytical framework based on the capabilities and human rights approaches (Nussbaum, 1997; Sen, 1999; Sepúlveda et al., 2004; Sen, 2005).

Finally, the specific aim of Chapter 5 was to complement the study by investigating the extent of intra-urban inequalities in child undernutrition in rapidly urbanising least developed countries. Child undernutrition was considered to represent an example of deprivation of the basic means of subsistence, referred to in the overarching research question 3. The main hypothesis was that countries undergoing most rapid pace of urbanisation are prone to experience greater intra-urban inequalities as compared to countries which have been urbanising at a less rapid pace. Research findings confirmed this hypothesis and additionally found that parents' educational attainment can further exacerbate the severity of existing inequalities. Moreover, the study confirmed that child's birth weight as well as mother's socio-economic background (in particular educational attainment) are significant predictors of child undernutrition. Conceptually, Chapter 5 proposed an analytical framework which facilitates the understanding of the multifaceted and interdisciplinary nature of inequalities. This framework can constitute a useful basis for future studies. The results of all three empirical chapters not only complement the existing research on the topic, but yield important policy implications, as will be discussed later in this chapter. Before turning to policy recommendations, it is important to consider theoretical and conceptual implications of the present study as well as study limitations.

6.2 Study limitations

Despite its contributions, this study has a number of limitations, as previously highlighted in Chapters 3-5. First, the reader might question the levels of analysis applied in each empirical chapter. For examples, Chapter 4 uses combined micro-macro level data to assess cross-level interaction effects. An ideal sample size would incorporate all 48 least developed countries. However, due to data limitations the study had to be restricted to 19 LDCs. An alternative way of developing the study design could have been to apply regression modelling on a long (country-level) panel data; however, this approach would not allow considering cross-level interaction effects. Similarly, in Chapter 3, it could be argued that a micro-level perspective is missing. Nevertheless, it is important to stress that the choice of macro-level analysis was driven by research questions which specifically referred to associations between countries. Second, and related to the first point, the focus of the whole thesis was on macro- and micro-level relationships. In this context, while the research considered community effects, it would be of added value if future studies examining similar topics focused specifically on the role of different community-level factors. As with other regression analyses, the limitation of the study is that it does not claim causal effects. Structural Equation Modelling might provide complementary results, in particular when examining the determinants of food security.

As highlighted previously, there are limitations related to the definitions of urban areas and potential reclassification of those over time. Thus, for example, in Ethiopia localities with 2,000 or more inhabitants are considered to be urban, while in Senegal the benchmark population is 10,000 people (United Nations, 2011b). Moreover, some countries may apply additional classification criteria related to density amongst buildings and administrative role of specific localities. Within-urban differentials also exist, although this limitation has been largely overcome by using the standard DHS categories for large cities, small cities and towns. While limitations attributable to definitions of urban areas might pose challenges in comparative analysis, as to the best of the author’s knowledge there are currently no alternatives to using the existing classifications. Although a standardisation exercise could be envisaged, it is likely that it would create a new set of questions.

Finally, as this study makes important conceptual contributions, readers can question proposed concepts, analytical frameworks or definitions. It should be highlighted that when developing each framework or definition utmost care has been taken to apply an evidence-based approach. Novel ideas always come with a risk, yet they are crucial to advancing science. It could be pointed out that the proposed post-Malthusian framework does not exactly follow the original one or that the classification of positive and preventive checks is slightly different from that developed by Malthus. Yet, on the other hand, the reader might appreciate that the very purpose of this thesis was to propose a framework which, while drawing from Malthus, would reflect contemporary phenomena and challenges. Another conceptual challenge is related to defining development and the levels of development. Given vast literature in this area and the scope of the subject, a decision has been made to use the existing classification of the levels of development proposed by UNDP. Finally, with regard to the definition of urbanisation, readers may question the differences between demographic processes (as drivers of urbanisation) and the concept of urbanisation itself. The key assumption of this thesis has been that, while strongly interconnected, demographic processes and urbanisation are two separate phenomena.

6.3 Revised post-Malthusian framework in the context of global urbanisation

One of the main goals of this thesis was to propose a revised post-Malthusian framework which could be applied to contemporary population and developmental studies. The revised framework presented in this section is based on three main foundations. First, it was motivated by the initial Malthusian theory, as presented in section 2.2.1. Second, the framework has been complemented by the concepts and definitions applied throughout this thesis (Box 6.1). Third, the development of the final reoriented Malthusian framework was informed by the empirical findings of Chapters 3-5.

Inasmuch, the framework presented in Figure 6.1[37] encompasses several levels of thought process and analysis. For thorough understanding, the framework should be read from both left to right as well as top to bottom. The top level comprises structural elements as highlighted in the original Malthusian framework and already discussed in section 2.2.1. They include societal inequalities, innovation and progress, and human nature. All these components are closely linked to each other and have an impact on key confounding factors as well as the revised feedback loop (bottom of the framework).

[37] The original elements of the Malthusian Theoretical Framework are highlighted in black, while the newly developed components are highlighted in red.

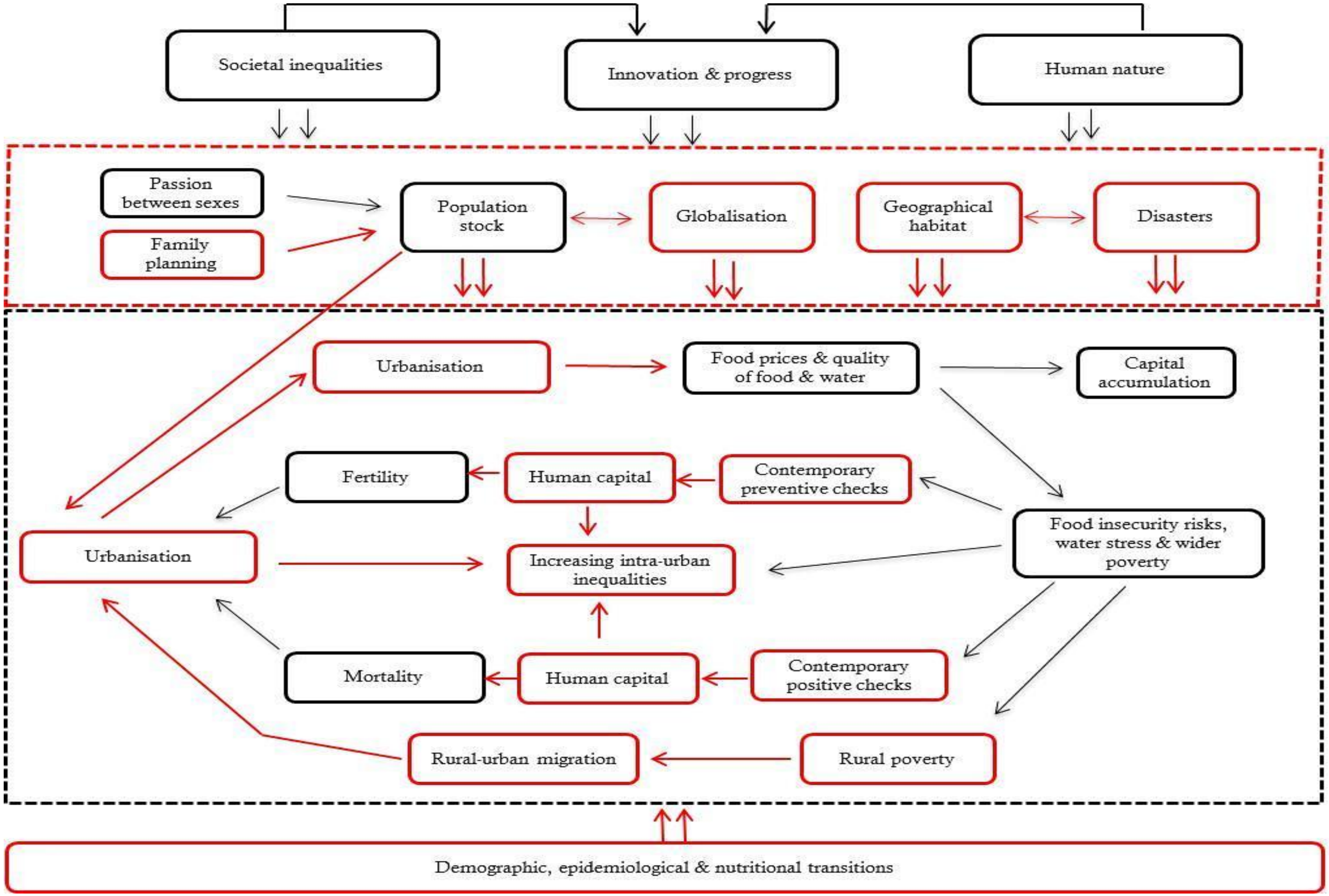

Figure 6.1 Post-Malthusian Framework.

Given the importance of securing access to food, the elites are in a perpetual fight to sustain the status quo where they are able to benefit from their privileged access to key resources. In the context of scarcity, as Malthus claimed "the hateful passions…reappear" and "the temptations to evil are too strong for human nature to resist" (Malthus, 1826, p.334). However, the state of societal inequalities has, to a certain degree, some advantages. For example, it triggers competition, which in turn brings about innovation and generation of human capital. This reasoning can be effectively applied to contemporary knowledge-based economies. Following on from Malthus, it should nonetheless be noted that large inequalities are detrimental to societal progress because they reduce consumer base and can lead to economic stagnation. Moreover, given the developmental progress achieved over the last two centuries, it ought to be recognised that, while inequalities can have a positive impact on countries' wealth, including citizens' well-being, universal access to key necessities should be guaranteed by law. This aspect of the Malthusian framework will be further referred to in the next section.

The second level of the Malthusian framework encompasses the main contemporary factors which affect availability of and access to vital resources, such as food and water. This part of the framework has been largely motivated by the research conducted in Chapter 3 (in particular section 3.4). Based on previous literature as well as the results of the analysis in Chapter 3, the main contemporary factors influencing food security are population stock, geographical habitat, natural disasters and conflicts (i.e. "disasters"), and globalisation. Population size can be seen as the most obvious factor because of its direct link to urban growth, but also because larger populations require greater supplies of food, water and other resources. Today, population size is affected by two counteracting forces. The first element is the traditional Malthusian passion between the sexes, which acts as a primary trigger of population growth. The second aspect relates to modern family planning. Despite the likelihood to have been classified by Malthus as a vice, family planning constitutes a key balancing force in the contemporary population size equation.

As discussed at length in Chapter 3, geographical habitat influences the way in which populations are distributed and can either support or hinder people's survival. Because of the surrounding natural habitat, individuals might be forced to migrate to cities, thus contributing to urbanisation. On the other hand, those communities which live in prosperous natural habitats are likely to be less affected by poverty and famines. Likewise, individuals and communities affected by wars and conflicts can suffer from disease and hunger. In addition, disasters can contribute to greater population displacements. Finally, as debated in Chapter 3, globalisation has a differentiated effect on food security and can influence urban trends through exchange of good, services and information. All the above-highlighted four sets of factors are influenced by the traditional Malthusian elements incorporated in the top layer of the framework.

The bottom level of the framework comprises a revised post-Malthusian feedback loop. While the focus of the traditional feedback loop was on population dynamics and preventive and positive checks operating on fertility and mortality, the emphasis of the proposed here feedback loop is on the role that urbanisation has in access to and availability of vital resources. As far as possible, the suggested feedback loop follows the original Malthusian logic while accounting for new elements. In this revised framework urbanisation constitutes a starting point. More specifically, the process of urbanisation and urbanisation outcomes (ramifications) can have an important impact on prices and quality of food and other key resources. This is likely to contribute to increasing urban poverty while at the same time allowing the privileged classes to gain greater profit (capital accumulation).

Two sets of *contemporary urban checks* can then operate. As highlighted in Chapter 2 (section 2.3.3), the first set, which is the equivalent of the Malthusian preventive checks, acts through deterrence and is related to “urban advantage”. This effect is further strengthened by the mitigating impact of human capital, both at the country and household level. On the other hand, the second set (i.e. *contemporary positive checks*) can function through an increased urban risk resulting in higher mortality rates. Pollution, disease and the consequences of disasters have been proved to have a strong negative effect in densely populated urbanities. In addition, urban lifestyle can be associated with higher risk of obesity and chronic diseases. Contemporary positive and preventive checks have an impact of the levels of mortality and fertility, as was the case in the original Malthusian framework. At the same time, increasing overall poverty contributes to greater rural poverty which acts as a push factor for migration to the cities. Together with natural increase due to higher fertility rates, increased rural-urban migration contributes to greater urbanisation, which closes the cycle.

Finally, it should be stressed that, while originally conceived as a macro-level framework, all elements of the suggested framework and associated relationships can be interpreted at different levels of analysis. From the process point of view, the phenomena enclosed in this feedback loop have been developing concurrently to the demographic, epidemiological and nutritional transitions to which they are closely linked. They can be also interpreted using the human rights and capabilities approach. Satisfying the need for food and water is conceptualised to be the key requirement for human survival and a substantive human right. As such, meeting this need constitutes the very basis for any further developmental progress, such as strengthening health systems or ensuring universal access to education.

6.4 Policy implications

The findings in this thesis yield implications for the post-MDG agenda, or developmental agenda, more broadly. The policy areas to which the suggested recommendations apply include the following: 1) population size and population growth, 2) urbanisation, 3) food security, 4) human capital and 5) inequalities. It should be stressed that design and implementation of specific policies is likely to be subject to a number of practical challenges. Such challenges may be linked to the lack of political will, resource constraints or difficulties in achieving consensus. In this context, the policy recommendations made in this section should be treated as the author's modest contribution to the current policy debates, rather than *sine qua non* recipes for success.

<u>Population size and population growth</u>

This study has been motivated by the traditional Malthusian debate concerning population growth and availability of natural resources. As highlighted in Chapter 2, around the time of the ICPD there was an important shift in terms of policy priorities in international development. The focus on family planning and reducing the pressure on the planet's resources was largely replaced by attention to reproductive and sexual rights in the context of a broader human rights framework. At the same time, scholars like Cleland (1996) argued against this perceived neglect of threats resulting from population growth, including the pressure on natural and health environment. Today, in the context of the post-MDG agenda, the neo-Malthusian *rhétorique* is regaining ground. Thus, as mentioned in Chapter 2, a recently released report by SSDN (2013) highlights that future sustainable development is only possible within planetary boundaries. At the same time, concerns are arising around the issue of low fertility and the need to bridge the gap between actual fertility rates and desired family size in low-fertility countries (Matthews et al., 2013).

Given this increasingly complex reality, policy implications of the present study should account for both the existing evidence of the impact of population size on environment and changing demographic trends. As reported in Chapter 3, at the macro-level high fertility rates can have a negative impact on food security; however, the significance of this association varies depending on confounding factors. Similarly, based on the results in Chapter 5, large households can be disadvantaged in terms of child undernutrition, yet, as in the previous case, this result is not systematically significant. On the other hand, when considering the results of Chapter 4, smaller households are less likely to have access to safe drinking water as compared to households with 10 or more people. This can be attributed to more efficient coping strategies of larger households and availability of "manpower" which can directly influence the need and ability to collect drinking water.

In this context, two policy recommendations can be made. First, there is need to account for the divergent goals of different interest groups and varying perceptions of ideal family size within and across countries. Second, it is crucial to ensure that measures pertaining to family planning are designed based on the existing human rights frameworks. Regarding the first point, in addition to accounting for the continuously debated macro-level impact of rapid population growth, policy initiatives should recognise that large families are often perceived as a benefit rather than a strain. As an illustration, the desired family size in sub-Saharan Africa remains relatively high, often exceeding four children per woman (World Bank, 2012b). This tension between a desire for relatively large families in some countries and regions and pro-family planning activists is likely to lead to challenges in designing effective policy initiatives.

In this context, the key question is whether complete global fertility convergence is really possible and, if not, what policy options should be made available. The priorities of low-fertility countries, including in Europe and East Asia, include creating pro-family policies encouraging couples to meet their desired family size. At the same time, this desired family size varies considerably from that in Africa or Middle East, which results from cultural and religious pre-conditions. If these trends remain constant, governments might need to resort to unprecedented collaboration in migration management so as to meet divergent needs of their respective populations, which could result in additional policy deadlocks.

Finally, a human rights-based approach is key. Without going into detailed discussion regarding reproductive and sexual health, it should be acknowledged that any debate pertaining to population size and population growth should adapt a human rights perspective. The human rights of individuals should include meeting their desired family size even if this implies an unbalanced rate of growth amongst national populations.

<u>Urbanisation</u>

The findings of this thesis have policy implications as far as urban processes and outcomes are concerned. The four key areas comprise the following 1) anticipating, monitoring and managing the rate of urban growth; 2) rural development and investments in peri-urban areas; and 3) investments in sustainable development of cities. With regard to the first point, both Chapters 3 and 4 found that the rate of urban growth is negatively associated with vital resources, including food security and access to safe drinking water. Complementarily, the results in Chapter 5 showed that rapid pace of urbanisation can exacerbate the extent of intra-urban inequalities in the least developed countries. In this context, an effective system of planning, which would include tight collaboration between local authorities, in crucial. Such a system should encompass data sharing as well as exchange of information on manpower needs, business environment, housing opportunities and infrastructure. This information should be disseminated to households residing in rural and peri-urban areas so as to reduce the gap between the expected benefits of migration and the real costs incurred by migrants. In addition, given the impact of rapid urbanisation on the environment (which can translate into food insecurity and water stress), environmental conservation agencies should establish close cooperation with population monitoring services. It is important that legal measures aimed at protecting the environment be implemented in anticipation of urban sprawl so as to prevent degradation of clean water and fertile farmland.

Secondly, there is a need to scale up investments in both rural and peri-urban areas. Although traditionally the focus has been on urban-rural divide, increasingly there has been recognition of intra-urban differentials. At the same time, while recent policy proposals (SDSN, 2013) stress the importance of rural development, peri-urban areas are often neglected. Yet, as highlighted in Chapters 3, 4 and 5, evidence suggests that residents of smaller urbanities are often at disadvantage when it comes to the risk of undernutrition or access to safe drinking water. In this context, investments should concentrate not only on modernisation of agriculture and improved food-processing technologies but also diversification of income-generating business projects. Initiatives aiming at creation of renewable energy sources provide a good example of such projects. For instance, the Commercializing Renewable Energy in India (CREI) scheme initiated in Andhra Pradesh provides opportunities for local entrepreneurs to identify sources of funding and build capacity required for business development in this relatively new sector (UN DESA, 2007). Importantly, micro-finance projects should contribute to increasing convergence in standard of living between cities, peri-urban areas and rural zones through enhanced cooperation between different localities.

Thirdly, large cities constitute a continuing challenge because of the effect they have on the environment. It is also in large cities where the biggest slums develop and where urban poverty and environmental degradation can have a potentially disastrous effect. While it has been universally recognised that cities constitute important trade and industry hubs and as such can drive economic development and innovation, living in cities can have non-negligible negative health effects. In the context of this research two key issues should be highlighted, i.e. policy implications related to the growing number of urban poor and/or slum dwellers in large cities and policy repercussions linked to health risks associated with city residence. Sustainable development initiatives targeted at large cities should therefore aim to account for the two above-mentioned phenomena. Undeniably, growing urban poverty is inherently related to overall lack of living wage job opportunities as well as structural heterogeneity of cities. Thus, any effective policy should concentrate on intra-city collaboration which would encompass such issues as spatial planning, migration management and inequality reduction initiatives. As highlighted by Montgomery and Ezah (2005a), heterogeneous neighbourhoods could be beneficial for health interventions and could motivate a greater number of volunteers for community-based activities. This, in turn, could create greater social cohesion and potentially reduce inequalities. In addition, as previously pointed out, slum upgrading programmes combined with scaling up macro-finance initiatives are likely to yield positive results (Satterthwaite, 2003, pp. 213-214).

Furthermore, as reported in Chapter 3, factors linked to living in large cities can have a detrimental effect on food security and resulting health risks. It is sensible to assume that households in peri-urban areas are more likely to have access to food both through their linkages to rural areas as well as by means of urban agriculture. Importantly, the quality of food in large urban centres combined with overall low level of physical activity can lead to overweight or obesity, which in turn generates the risk of diabetes and cardiovascular diseases. These risks are relevant in both developing and developed countries. In this context, policy initiatives should include wide-scale public health programmes targeted at selected segments of population. The issues pertaining to food security will be the subject of the next section.

Food security

While the previous section touched upon the issue of food security in the context of policy recommendations related to urbanisation, this section focuses solely on policy questions pertaining to food insecurity risks based chiefly on the findings of Chapter 3. As postulated in this thesis, as well as elsewhere (Szabo, 2013), given the multidimensional nature of the food security concept, the interpretation of the food security concept should be re-assessed. Policy measures should aim at such solutions so as to anticipate the known food insecurity risks and thus prevent food insecurity outcomes (i.e. death, hunger or obesity/overweight). Accounting for the aforementioned considerations, concrete policy measures fall under three categories: first, re-orienting the concept of food insecurity; second, investing and planning in the area of hunger averting actions; and third, preventing and reducing the global burden of obesity at the global and national levels.

With regard to the first implication, as already highlighted in Chapter 3, the interpretation and measurement of the food insecurity definition developed by FAO (2012c; 2013) should be used as a basis to consider both food security risks and outcomes. A clear distinction should be made between input and output indicators and the latter need to encompass comprehensive categories of nutritional status. Outcome indicators of poor diet should be included in the list of official food security indicators. Given the international effort required to collect and process data, this is likely to create operational and potentially political challenges. However, existing databases show that successful collaboration in data collection is possible.

As far as hunger prevention is concerned, policy initiatives should target the most vulnerable groups. In this respect, food availability should involve investing in adequate food storage, agricultural trade agreements and food distribution channels. These recommendations have been stressed by previous research (Lofchie, 1975; Sen, 1983b; de Waal, 2009). At the same time, as highlighted previously, the current political, institutional and economic systems are likely to hinder an equitable distribution of resources. Similarly, within countries stark inequalities exist. As shown in Chapter 4, in the least developed countries access to safe drinking water is worst in rural areas followed by towns. In addition, poor households with low levels of education are particularly disadvantaged and should therefore be targeted as priority groups.

Finally, overweight and obesity have become major contemporary public health problems. In order to efficiently tackle these challenges, governments should implement strict policy measures aimed at both promoting healthy nutrition and banning sales of harmful food. With regard to the first point, public health campaigns should focus on raising awareness of the consequences of fast food consumption. Popular science programmes and short multimedia spots should focus on conveying key messages by showing the chemical composition of food products and the impact these substances can have on human health. A key challenge in this respect is related not only to individual behaviour and consumption preferences but also price regulations. Through price regulations, healthy food options need to be more accessible as compared to processed food, which is often lacking in nutritional value. In the context of increased globalisation and interdependency between countries, food quality standards should be subject of strict international agreements. Ideally, healthy food promotion policies should be linked to tariff regimes, with food products high in nutritional contents benefiting from lower tariffs.

Human capital

One of the key results of this study has been that human capital is critical in terms of directly affecting households' welfare and survival as well as attenuating both macro- and micro-level impacts of urbanisation on food security and access to safe drinking water. This has several important implications, which can be categorised under two broader policy initiatives. First, targeted investments in education are needed, including curriculum strengthening. Second, focus on research and development should be the basis for innovation and economic growth.

With regard to the first point, as highlighted in Chapter 4 and in line with the current developmental debate and proposed developmental goals, access to universal education is a *sine qua non* condition for maximising one's chances of a better standard of living. Education influences behavioural change and is often a key factor behind individual choices. Therefore, educational policies should focus not only on primary schools, which is emphasised through current MDGs (UN, 2013b), but also targeted trainings, provision of practical skills and professional qualifications. Curricula should be adapted in such a way so as to respond to the specific human development needs of the country as well as future employment opportunities. Thus, for examples, in countries with high undernourishment rates amongst poor children, practical courses about nutrition aimed at children, youth and a range of social actors should be provided together with promotion of income-generating opportunities. Post-secondary education should focus on responding to the economic needs of the country, which in turn is likely to generate incentives for young people to benefit from working opportunities in their homelands thus preventing brain drain. This is particularly important in a context where, due to urbanisation, a continuously growing proportion of people rely on paid employment for meeting their most basic needs.

Secondly, collaboration between the private sector, academia and regulatory bodies is crucial. This is due to the increasing importance of research and development (R&D) which allows bringing about innovation and technological advancement. Commitment to R&D involves not only financial investments but also an adequate regulatory framework. In the case of agriculture this should involve laws and guidelines related to property rights, environmental safety and health protection. Pardey et al. (2006) highlighted that, while in the developed countries private companies have been investing in biotechnological research, this trend is likely to follow in less developed nations, although it might require greater public involvement and significant resources. In this context, the focus on regulatory frameworks, albeit potentially challenging in practice, is key to sustained technological advancements.

<u>Inequalities</u>

Finally, despite progress in the reduction of traditional poverty indicators, an increasingly salient challenge lies in growing inequality gaps. In the context of the present thesis, six different aspects of inequality areas have been distinguished. These are spatial, economic (income or asset-based), demographic, gender, educational and sociological inequalities. As highlighted previously, when discussing the nature of inequalities (section 5.3), inequalities can exist at micro, meso and micro levels. From the public policy perspective, a key question that arises is what measures can effectively tackle the rising inequalities between the best off and the most disadvantaged.

Based on the empirical evidence provided in this thesis, the following broad policy initiatives are suggested: first, developing a holistic approach accounting for different aspects of inequalities; second, designing policy measures targeting the marginalised groups identified through evidence-based research; third, recognising that equality of opportunities requires large-scale investments in infrastructure; and fourth, mobilising local, national and global communities for action, including through volunteer and paid programmes. With regard to the first point, the specific examples of potential policy interventions include prioritising access to safe drinking water amongst the most deprived households living in rural and peri-urban areas. Similarly, in the case of child undernutrition the poorest urban households should be targeted. As results of Chapter 5 suggest, in the LDCs, boys rather than girls require greater attention when it comes to undernourishment. Indirect interventions include investments in education especially amongst the urban poor as well as overall poverty elevation measures. The priority groups are likely to change when considering different health outcomes and overall human development level. Thus, for example, concerning the challenges linked to obesity, large cities and peri-urban areas should be prioritised through targeted public health interventions.

Second, while overall trends show that wealthier, more educated, smaller urban households are better off, caution is required when designing policy measures aimed at bridging inequality gaps. Thus, while both rural and urban poor appear to be the obvious target groups, evidence suggests that other categories can be more affected by adverse outcomes. A pertinent example is that of household size effects. The findings of Chapter 4 suggest that smaller households are at a disadvantage when it comes to access to safe drinking water. As discussed previously, this can be caused by a range of factors, including lack of "manpower" to collect water, generate a water source, or provide income. Policy interventions should therefore prioritise small households, in particular those in remote areas or with poor infrastructure. On the other hand, Chapter 5 showed that household size can have a negative effect on child undernourishment, which highlights the need to provide targeted nutritional support to larger households. Combining these competing priorities can pose a severe challenge when designing effective policy interventions.

Third, inequalities are linked to poor infrastructure and broader environmental factors. This has been illustrated by empirical evidence in Chapters 4 and 5. Both macro- and micro-level infrastructure, such as distance to a source of safe drinking water and a country's road system can have a significant positive effect on households' water access. Similarly, structural differences, such as pace of urbanisation, can exacerbate existing inequalities. This suggests that equitable development of the country's and neighbourhood's infrastructure is crucial for reducing the degree of inequalities. The example of developed countries suggests that nations with affordable public transportation (e.g. countries in Europe) have lower economic inequalities as compared to countries with reliance on private transportation (e.g. US) (OECD, 2008, 2011). Naturally, developing an efficient physical infrastructure requires considerable financial investments, which may not be available in low income countries.

Finally, community mobilisation should be prioritised as a key aspect of inequality reduction agendas. Such engagement could contribute to decreasing different facets of inequalities. As highlighted previously, inequalities in human capital can have a particularly detrimental effect given the strong direct association and indirect impact of human capital on access to basic necessities, such as food and water. In addition, accounting for the fact that poor education can translate into technological illiteracy, investments in education should be a key aspect of cross-sectoral strategies aimed at bridging the gaps between the most advantaged and the most disadvantaged. Community mobilisation programmes could help recruit and coordinate volunteers to train the most vulnerable groups in practical daily life skills, such as water purification, as well as assist in longer-term capacity development. At the same time, with regard to reducing demographic inequalities linked to household size, targeted programmes should concentrate on reducing the gaps between the desired and actual family size. In developing countries, this can be achieved not only through family-planning programmes, but also through policies aiming at eliminating child marriage and thus lowering the adolescent fertility rates.

As with other thematic areas, policies aiming at inequality reduction require complex solutions and are likely to enquinter a number of practical challenges which may hinder the intended results.

6.5 Directions for future research

While doctoral research projects allow the answering of only a set of specific research questions, they also contribute to conceptualising new policy-oriented research problems. The present study is no different. Given its emphasis on macro-level issues as well as the use of quantitative methods and statistical tools, future studies could complement this research by applying alternative analytical strategies. Potential research approaches could involve qualitative case studies and historical analysis. Qualitative studies could be designed to investigate the perceptions of households and individuals on the impact of urbanisation on their livelihoods. Historical analysis could be conducted drawing on Boserup's work regarding the impact of technology on agricultural output. Such analysis could focus on the past and present effects of urbanisation on evolving food security challenges, including nutritional outcomes. In addition, following on from Simon's pioneering work on the impact of human capital on access to vital resources, a trend analysis could be undertaken investigating the impact of human capital on water access in historical and contemporary societies. With regard to the potential extension of quantitative methods applied in this thesis, future studies could complement this research by incorporating community-level indicators in order to investigate their potential effects on the outcome variable. Moreover, path analysis or structural equation modelling is likely to provide further insights related to this study's findings. The latent variable approach could be used both for the analysis of food insecurity risks and nutritional outcomes.

As highlighted at the outset of this thesis, the Malthusian theory has been primarily based on the postulates made by Malthus in several volumes of his *Essay on the Principle of Population*. Future studies could focus on drawing more extensively from other Malthusian scholarship, including the *Principles of Political Economy*. This approach could allow a more comprehensive analysis of the interlinkages between Malthus' arguments and contemporary developmental obstacles.

Finally, in terms of potential larger-scale research projects, two specific initiatives could be envisaged. The first potential research project could focus on compiling a repository of evaluation studies assessing policy programmes in poor urban areas or otherwise related to the consequences of rapid urbanisation. In particular, policies addressing increasing intra-urban inequalities would be aimed at. To this end, relevant policy programmes would need to be identified and evaluation studies carried out. The final product, an online repository, would constitute a useful platform for both policymakers and development practitioners. The initial target would be the least developed countries; however, the project could be extended based on the generated interest and available funding. The second study could involve a comprehensive analysis of inequalities in food security status encompassing different aspects of food security. The choice of study sites would need to be carefully crafted and should involve close collaboration with local stakeholders. Given the evidence provided in this thesis, rapidly urbanising least developing countries should be given priority. An additional priority group could target the countries which suffer from the most severe double burden of malnutrition.

All these studies would contribute to the advancement of knowledge pertaining to the risks and opportunities created by contemporary urbanisation. Given the fact that urban growth is projected to continue, it is timely to focus academic attention on the existing and emerging challenges resulting from urbanisation. Referring back to the Malthusian framework and the foundations laid in Malthus' scholarship is likely to continue to offer useful tools for further investigation.

APPENDICES

APPENDIX A LIST OF LDCS

Table A.1 List of Least Developed Countries.

List of Least Developed Countries (LDCs)			
Africa			
Angola	Benin	Burkina Faso	Burundi
Cape Verde	Central African Republic	Chad	Comoros
Congo, Dem. Rep. of the	Djibouti	Equatorial Guinea	Eritrea
Ethiopia	Gambia	Guinea	Guinea-Bissau
Lesotho	Liberia	Madagascar	Malawi
Mali	Mauritania	Mozambique	Niger
Rwanda	Sao Tome and Principe	Senegal	Sierra Leone
Somalia	Sudan	Tanzania	Togo
Uganda	Zambia		
Asia			
Afghanistan	Bangladesh	Bhutan	Cambodia
Lao PDR	Maldives	Myanmar	Nepal
Timor-Leste	Yemen		
Australia and the Pacific			
Kiribati	Samoa	Solomon Islands	Tuvalu
Vanuatu			
Caribbean			
Haiti			

Source: List of Least Developed Countries (UN, 2013a).

APPENDIX B SUMMARY OF NATIONAL URBAN DEFINITIONS

DEFINITION OF "URBAN"

"**AFRICA**

Algeria: The urban/rural delimitation is performed after the census operation based on the classification of built-up areas. Groupings of 100 or more constructions, distant less than 200 metres from one another are considered urban.

Botswana: Agglomeration of 5,000 or more inhabitants where 75 per cent of the economic activity is non-agricultural.

Burundi: Commune of Bujumbura.

Burkina Faso: All administrative centres of provinces (total of 45) plus 4 medium-sized towns are considered as urban areas.

Comoros: Every locality or administrative centre of an island, region or prefecture that has the following facilities: asphalted roads, electricity, a medical centre, telephone services, etc.

Egypt: Governorates of Cairo, Alexandria, Port Said, Ismailia, Suez, frontier governorates and capitals of other governorates, as well as district capitals (Markaz). The definition of urban areas for the November 2006 census is "SHIAKHA", a part of a district.

Equatorial Guinea: District centres and localities with 300 dwellings and/or 1,500 inhabitants or more.

Ethiopia: Localities of 2,000 or more inhabitants.

Kenya: Areas having a population of 2,000 or more inhabitants that have transport systems, build-up areas, industrial/manufacturing structures and other developed structures.

Lesotho: All administrative headquarters and settlements of rapid growth.

Liberia: Localities of 2,000 or more inhabitants.

Malawi: All townships and town planning areas and all district centres.

Mauritius: Towns with proclaimed legal limits.

Namibia: Proclaimed urban areas for which cadastral data is available and other unplanned squatter areas.

Niger: Capital city, capitals of the departments and districts.

Rwanda: All administrative areas recognised as urban by the law. These are all administrative centres of provinces, and the cities of Kigali, Nyanza, Ruhango and Rwamagana.

Senegal: Agglomerations of 10,000 or more inhabitants.
South Africa: Places with some form of local authority.
Sudan: Localities of administrative and/or commercial importance or with population of 5,000 or more inhabitants.
Swaziland: Localities proclaimed as urban.
Tunisia: Population living in communes.
Uganda: Gazettes, cities, municipalities and towns.
United Republic of Tanzania: 16 gazetted townships.
Zambia: Localities of 5,000 or more inhabitants, the majority of whom all depend on non-agricultural activities.

AMERICA, NORTH

Canada: Places of 1,000 or more inhabitants, having a population density of 400 or more per square kilometre.
Costa Rica: Administrative centres of cantons.
Cuba: Towns that fulfil a political or administrative function or that have a population of 2,000 or more and definite urban characteristics.
Dominican Republic: Administrative centres of municipalities and municipal districts, some of which include suburban zones of rural character.
El Salvador: Administrative centres of municipalities.
Greenland: Localities of 200 or more inhabitants.
Guatemala: Municipality of Guatemala Department and officially recognised centres of other departments and municipalities.
Haiti: Administrative centres of communes.
Honduras: Localities of 2,000 or more inhabitants, having essentially urban characteristics.
Jamaica: Localities of 2,000 or more inhabitants, having urban characteristics.
Mexico: Localities of 2,500 or more inhabitants.
Nicaragua: Administrative centres of municipalities and localities of 1,000 or more inhabitants or with more than 150 dwellings, with streets, electric light, water service, school and health centre.
Panama: Localities of 1,500 or more inhabitants having essentially urban characteristics.
Beginning 1970, localities of 1,500 or more inhabitants with such urban characteristics as streets, water supply systems, sewerage systems and electric light.

Puerto Rico: Agglomerations of 2,500 or more inhabitants, generally having population densities of 1,000 persons per square mile or more. Two types of urban areas: urbanised areas of 50,000 or more inhabitants and urban clusters of at least 2,500 and less than 50,000 inhabitants.
United States of America: Agglomerations of 2,500 or more inhabitants, generally having population densities of 1,000 persons per square mile or more. Two types of urban areas: urbanised areas of 50,000 or more inhabitants and urban clusters of at least 2,500 and less than 50,000 inhabitants.
United States Virgin Islands: Agglomerations of 2,500 or more inhabitants, generally having population densities of 1,000 persons per square mile or more. Two types of urban areas: urbanised areas of 50,000 or more inhabitants and urban clusters of at least 2,500 and less than 50,000 inhabitants. (As of Census 2,000, no urbanised areas are identified in the United States Virgin Islands.)

AMERICA, SOUTH
Argentina: Populated centres with 2,000 or more inhabitants.
Bolivia: Localities of 2,000 or more inhabitants.
Brazil: Urban and suburban zones of administrative centres of municipalities and districts.
Chile: Areas of concentrated housing units with more than 2,000 inhabitants, or between 1,001 and 2,000 inhabitants having 50 per cent or more of its economically active population doing secondary or tertiary activities. As an exception, centres of tourism and recreation with more than 250 housing units that do not satisfy the population requirement are nevertheless considered urban.
Colombia: Administrative centres of municipalities.
Ecuador: Capitals of provinces and cantons.
Falkland Islands (Malvinas): Town of Stanley.
Paraguay: Cities, towns and administrative centres of departments and districts.
Peru: Populated centres with 100 or more dwellings.
Suriname: The districts of Paramaribo and Wanica.
Uruguay: Cities.
Venezuela (Bolivarian Republic of): Centres with a population of 1,000 or more inhabitants.

ASIA

Armenia: Cities and urban-type localities, officially designated as such, usually according to the criteria of number of inhabitants and predominance of agricultural, or number of non-agricultural workers and their families.

Azerbaijan: An administrative division which covers more than 15,000 population, engaging mainly in industrial and other economic and social activities and which include administrative and cultural centres.

Bahrain: Communes or villages of 2,500 or more inhabitants.

Cambodia: Areas at the commune level satisfying the following three conditions: (1) Population Density exceeding 200 per square Km, (2) Percentage of male employed in agriculture below 50 per cent, (3) Total population of the commune exceeds 2,000 inhabitants.

China: Cities only refer to the cities proper of those designated by the State Council. In the case of cities with district establishment, the city proper refers to the whole administrative area of the district if its population density is 1,500 people per kilometre or higher; or the seat of the district government and other areas of streets under the administration of the district if the population density is less than 1,500 people per kilometre. In the case of cities without district establishment, the city proper refers to the seat of the city government and other areas of streets under the administration of the city. For the city district with the population density below 1,500 people per kilometre and the city without district establishment, if the urban construction of the district or city government seat has extended to some part of the neighbouring designated town(s) or township(s), the city proper does include the whole administrative area of the town(s) or township(s).

Cyprus: Urban areas are those defined by local town plans.

Georgia: Cities and urban-type localities, officially designated as such, usually according to the criteria of number of inhabitants and predominance of agricultural, or number of non-agricultural workers and their families.

India: Towns (places with municipal corporation, municipal area committee, town committee, notified area committee or cantonment board); also, all places having 5,000 or more inhabitants, a density of not less than 1,000 persons per square mile or 400 per square kilometre, pronounced urban characteristics and at least three fourths of the adult male population employed in pursuits other than agriculture.

Indonesia: Area which satisfies certain criteria in terms of population density, percentage of agricultural households, and a number of urban facilities such as roads, formal education facilities, public health services, etc.

Iran (Islamic Republic of): Every district with a municipality.
Israel: Localities with 2,000 or more residents. Japan: City (shi) having 50,000 or more inhabitants with 60 per cent or more of the houses located in the main built-up areas and 60 per cent or more of the population (including their dependants) engaged in manufacturing, trade or other urban type of business.
Jordan: Localities of 5,000 or more inhabitants.
Kazakhstan: Cities and urban-type localities, officially designated as such, usually according to the criteria of number of inhabitants and predominance of agricultural, or number of non-agricultural workers and their families.
Kyrgyzstan: Cities and urban-type localities, officially designated as such, usually according to the criteria of number of inhabitants and predominance of agricultural, or number of non-agricultural workers and their families.
Lao People's Democratic Republic: Areas or villages that satisfy at least three of the following five conditions: located in metropolitan areas of district or province, there is access to road in dry and rainy seasons, about 70 per cent or 2/3 of the population has access to piped water, about 70 per cent or 2/3 of the population has access to public electricity, there is a market operating every day.
Occupied Palestinian Territory: Localities with 10,000 or more residents. In addition, it refers to all localities whose populations vary from 4,000 to 9,999 persons provided they have, at least, four of the following elements: public electricity network, public water network, post office, health center with a full time physician and a school offering a general secondary education certificate.
Malaysia: Areas with population of 10,000 or more.
Maldives: Malé, the capital.
Mongolia: Capital and district centres.
Pakistan: Places with municipal corporation, town committee or cantonment.
Philippines: Cities and municipalities and their central districts with a population density of at least 500 persons per square km. Urban areas are considered other districts regardless of population size that have streets, at least six establishments (commercial, manufacturing, recreational and/or personal services), and at least three public structures such as town hall, church, public park, school, hospital, library, etc.
Republic of Korea: For estimates: Places with 50,000 or more inhabitants. For census: the figures are composed in the basis of the minor administrative divisions such as Dongs (mostly urban areas) and Eups or Myeons (rural areas).

Sri Lanka: Urban sector comprises of all municipal and urban council areas.
Syrian Arab Republic: Cities, Mohafaza centres and Mantika centres, and communities with 20,000 or more inhabitants.
Tajikistan: Cities and urban-type localities, officially designated as such, usually according to the criteria of number of inhabitants and predominance of agricultural, or number of non-agricultural workers and their families.
Thailand: Municipal areas.
Turkey: Province and district centres.
Turkmenistan: Cities and urban-type localities, officially designated as such, usually according to the criteria of number of inhabitants and predominance of agricultural, or number of non-agricultural workers and their families.
Uzbekistan: Cities and urban-type localities, officially designated as such, usually according to the criteria of number of inhabitants and predominance of agricultural, or number of non-agricultural workers and their families.
Viet Nam: Urban areas include inside urban districts of cities, urban quarters and towns. All other local administrative units (communes) belong to rural areas.

EUROPE
Albania: Towns and other industrial centres of more than 400 inhabitants.
Austria: Urban areas are localities with 2,000 or more inhabitants. The delineation of localities goes back to 1991.
Belarus: Urban settlements are settlements authorised under the law as towns, urban-type settlements, workers settlements and health resort areas.
Bulgaria: All towns and cities according to the Territorial and Administrative-Territorial Division of the country.
Czech Republic: Localities with 2,000 or more inhabitants.
Estonia: Urban settlements include cities, cities without municipal status and towns.
Finland: Urban communes.
France: Communes containing an agglomeration of more than 2,000 inhabitants living in contiguous houses or with not more than 200 metres between houses, also communes of which the major portion of the population is part of a multicommunal agglomeration of this nature.
Greece: Urban is considered every municipal or communal department of which the largest locality has 2,000 inhabitants and over.
Hungary: Budapest and all legally designated towns.

Iceland: Localities of 200 or more inhabitants.
Ireland: Cities and towns including suburbs of 1,500 or more inhabitants.
Latvia: Cities and urban-type localities, officially designated as such, usually according to the criteria of number of inhabitants and predominance of agricultural, or number of non-agricultural workers and their families.
Lithuania: Urban population refers to persons who live in cities and towns, i.e., the population areas with closely built permanent dwellings and with the resident population of more than 3,000 of which 2/3 of employees work in industry, 102 social infrastructure and business. In a number of towns the population may be less than 3,000 since these areas had
already the status of "town" before the law was enforced (July 1994).
Malta: Areas with population density of 150 persons or more per square km.
Netherlands: Urban: Municipalities with a population of 2,000 and more inhabitants. Semi-urban: Municipalities with a population of less than 2,000 but with not more than 20 per cent of their economically active male population engaged in agriculture, and specific residential municipalities of commuters.
Poland: Towns and settlements of urban type, e.g. workers' settlements, fishermen's settlements, health resorts.
Portugal: Agglomeration of 10,000 or more inhabitants.
Republic of Moldova: Cities and urban-type localities, officially designated as such, usually according to the criteria of number of inhabitants and predominance of agricultural, or number of non-agricultural workers and their families.
Romania: Cities, municipalities and other towns.
Russian Federation: Cities and urban-type localities, officially designated as such, usually according to the criteria of number of inhabitants and predominance of agricultural, or number of non-agricultural workers and their families.
Slovakia: The municipalities with the status of town having 5,000 inhabitants or more.
Slovenia: Settlements of 3,000 or more inhabitants, settlements that serve as seats of municipalities with at least 1,400 inhabitants, and sub-urban areas that are being gradually integrated with an urban settlement of 5,000 or more inhabitants.
Spain: Localities of 2,000 or more inhabitants.
Switzerland: Communes of 10,000 or more inhabitants, including suburbs.
Ukraine: Cities and urban-type localities, officially designated as such, usually according to the criteria of number of inhabitants and predominance of agricultural, or number of non-agricultural workers and their families.

United Kingdom of Great Britain and Northern Ireland: Settlements where the population is 10,000 or above.

OCEANIA

Australia: An urban centre is generally defined as a population cluster of 1,000 or more people.
American Samoa: Agglomerations of 2,500 or more inhabitants, generally having population densities of 1,000 persons per square mile or more. Two types of urban areas: urbanised areas of 50,000 or more inhabitants and urban clusters of at least 2,500 and less than 50,000 inhabitants. (As of Census 2,000, no urbanised areas are identified in American Samoa.)
Guam: Agglomerations of 2,500 or more inhabitants, generally having population densities of 1,000 persons per square mile or more, referred to as "urban clusters".
New Caledonia: Nouméa and communes of Païta, Nouvel Dumbéa and Mont-Dore.
New Zealand: All cities, plus boroughs, town districts, townships and country towns with a population of 1,000 or more usual residents.
Northern Mariana Islands: Agglomerations of 2,500 or more inhabitants, generally having population densities of 1,000 persons per square mile or more. Two types of urban areas: urbanised areas of 50,000 or more inhabitants and urban clusters of at least 2,500 and less than 50,000 inhabitants.
Vanuatu: Luganville centre and Vila urban."

Source: United Nations Demographic Yearbook (UN DESA, 2012b).

APPENDIX C RESULTS OF THE MULTINOMIAL REGRESSION USED FOR TEXT BOX 3.1.

Table C.1 Results of unadjusted multinomial regression accounting for levels of development.

Type of residence	Underweight (RRR)			overweight/obesity (RRR)		
	Most developed	Medium developed	Least developed	Most developed	Medium developed	Least developed
Capital, large city	0.85 (.04)***	.59 (.02)***	.71 (.02)***	1.42 (.07)***	1.8 (.06)***	3.43 (.14)***
Small city	.76 (.1)**	.75 (.03)***	.63 (.03)***	2.29 (.22)***	2.63 (.11)***	3.96 (.20)***
Town	0.78 (.05)***	.75 (.02)***	.62 (.02)***	1.53 (.09)***	3.22 (.09)***	5.32 (.19)***
Baseline: countryside	1.00	1.00	1.00	1.00	1.00	1.00
Constant	.34 (0.01)***	.56 (0.01)***	.73 (.01)***	.27 (0.01)***	.17 (0.00)***	.09 (.00)***
Log likelihood	-13,198	-53,404	-46,935	-13,198	-53,404	-46,935
n	14,070	56,411	51,127	14,070	56,411	51,127

Notes: ** p≤0.05, *** p≤0.01; Standard Errors (SE) are reported in parentheses. Data source: National Family Health. Survey (NFHS-3) 2005-06. Female data only.

APPENDIX D SCREE PLOTS SHOWING THE FRACTION OF TOTAL VARIANCE IN THE DATA (CHAPTER 3)

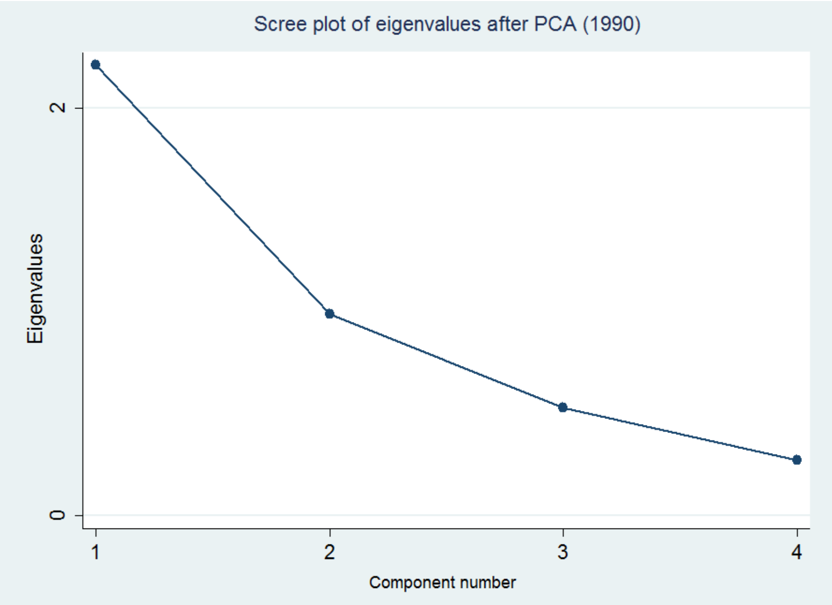

Figure D.1 Scree plot for determination of number of components retained for FIRI (1990).

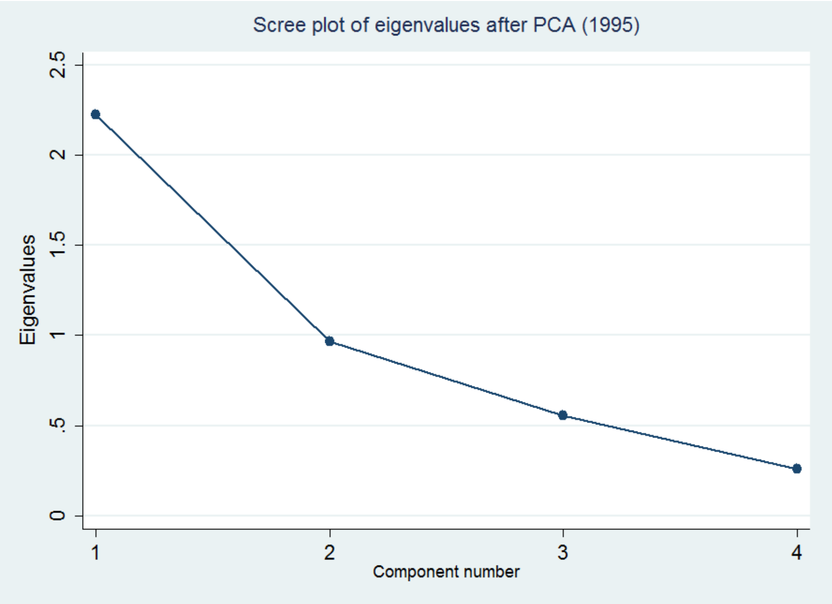

Figure D.2 Scree plot for determination of number of components retained for FIRI (1995).

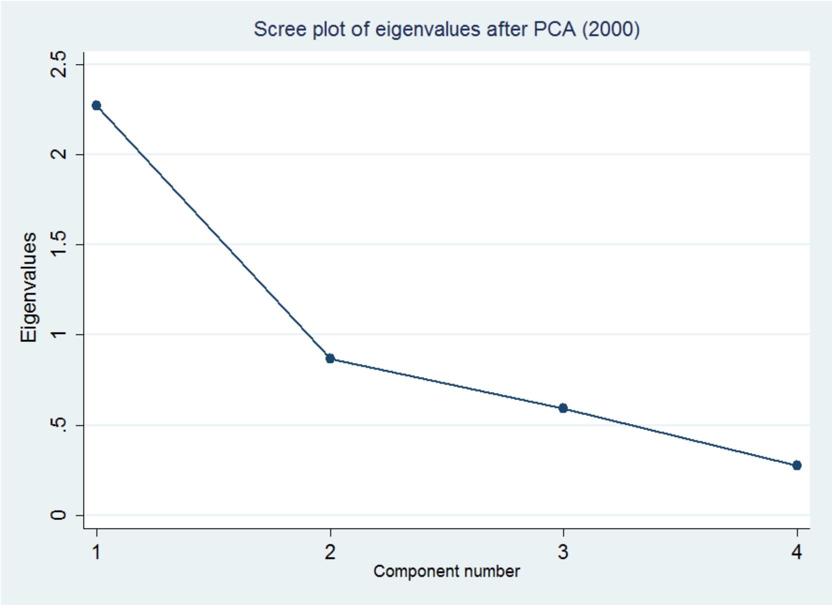

Figure D.3 Scree plot for determination of number of components retained for FIRI (2000).

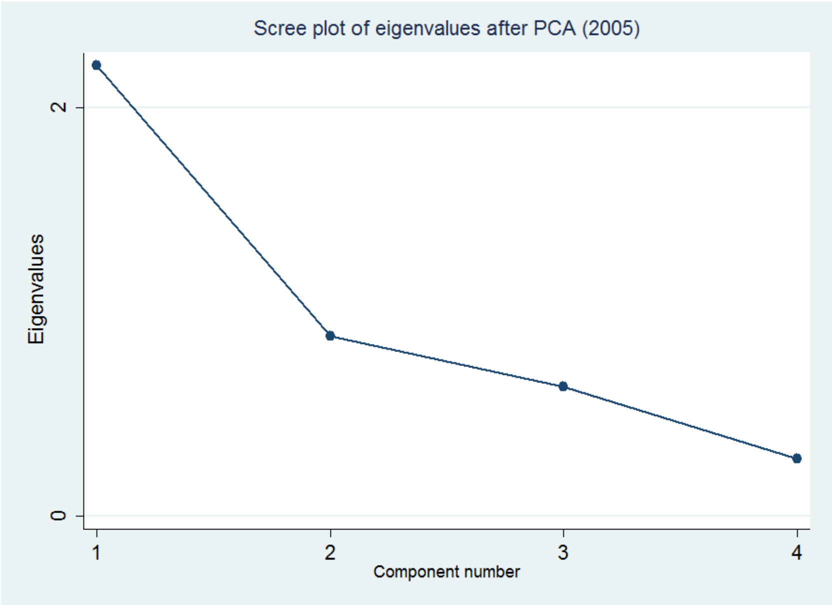

Figure D.4 Scree plot for determination of number of components retained for FIRI (2005).

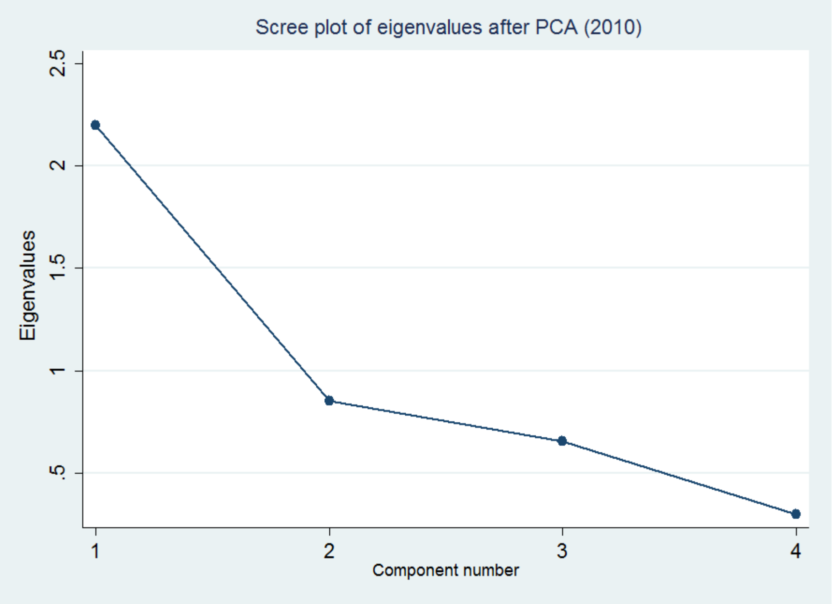

Figure D.5 Scree plot for determination of number of components retained for FIRI (2010).

APPENDIX E FOOD INSECURITY RISK INDEX (FIRI) – 2010 RANKING

Table E.1 Food Insecurity Risk Index (FIRI) – 2010 ranking.

	Low risk		Medium risk		High risk
1	New Zealand	59	Bosnia and Herzegovina	117	Palestine
2	Denmark	60	Armenia	118	Vanuatu
3	Ireland	61	Barbados	119	Gabon
4	Australia	62	Cuba	120	Swaziland
5	United States of America	63	Uzbekistan	121	Nicaragua
6	Netherlands	64	Kyrgyzstan	122	Mauritania
7	Iceland	65	Latvia	123	**Botswana**
8	Canada	66	Belize	124	**Indonesia**
9	Argentina	67	Algeria	125	Cameroon
10	Uruguay	68	Saudi Arabia	126	Sudan
11	**Israel**	69	Slovakia	127	Pakistan
12	**Spain**	70	Guyana	128	Malawi
13	Greece	71	China	129	Bangladesh
14	France	72	Maldives	130	Senegal
15	Lithuania	73	The former Yugoslav Republic of Macedonia	131	**Bolivia (Plurinational State of)**
16	Italy	74	Azerbaijan	132	**Cambodia**
17	Portugal	75	Paraguay	133	**Nigeria**
18	Austria	76	Libya	134	Burkina Faso
19	Luxembourg	77	Jordan	135	Mali
20	Finland	78	Bahamas	136	Namibia
21	Belgium	79	Brunei Darussalam	137	Rwanda
22	Kazakhstan	80	Venezuela (Bolivarian Republic of)	138	Niger
23	Germany	81	Cuba	139	Angola
24	Turkey	82	Mauritius	140	Yemen
25	Sweden	83	South Africa	141	India
26	Hungary	84	Samoa	142	Solomon Islands
27	Norway	85	Thailand	143	Nepal
28	Slovenia	86	Morocco	144	Côte d'Ivoire
29	**Malta**	87	Republic of Moldova	145	Lesotho
30	**Poland**	88	Ecuador	146	Kenya
31	United Kingdom	89	Seychelles	147	Ghana
32	Belarus	90	Montenegro	148	Zambia
33	Kuwait	91	Fiji	149	Zimbabwe
34	Romania	92	Georgia	150	Central African Republic
35	Chile	93	Antigua and Barbuda	151	Gambia
36	Switzerland	94	**Kiribati**	152	Benin
37	**Brazil**	95	**Viet Nam**	153	Chad
38	**Turkmenistan**	96	Jamaica	154	Uganda
39	Czech Republic	97	Colombia	155	Guinea
40	Ukraine	98	El Salvador	156	Burundi
41	Estonia	99	Myanmar	157	Ethiopia
42	Albania	100	Peru	158	Timor Leste
43	Iran (Islamic Republic of)	101	**Saint Lucia**	159	Togo
44	Tunisia	102	**Trinidad and Tobago**	160	United Republic of Tanzania
45	United Arab Emirates	103	Papua New Guinea	161	Madagascar
46	Egypt	104	Saint Vincent and the Grenadines	162	Afghanistan
47	Costa Rica	105	Saint Kitts	163	Guinea-Bissau
48	Malaysia	106	Honduras	164	Cape Verde
49	Republic of Korea	107	Mongolia	165	**Congo (Brazaville)**
50	**Croatia**	108	Panama	166	**Sao Tome and Principe**
51	**Mexico**	109	Guatemala	167	Democratic Republic of the Congo
52	**Serbia**	110	Dominican Republic	168	Sierra Leone
53	Bulgaria	111	**Suriname**	169	Mozambique
54	Japan	112	**Sri Lanka**	170	Haiti
55	Syrian Arab Republic	113	Tajikistan	171	Liberia
56	Lebanon	114	**Grenada**	172	Djibouti
57	Russian Federation	115	**Philippines**	173	Comoros
58	Dominica	116	Lao People's Democratic Republic	174	Eritrea

Note: Highest ranking denotes highest food insecurity risk. Index scores based on author’s calculations using FAO data. Bold font indicates equal ranking.

APPENDIX F FULL REGRESSION MODELS AND SELECTED PREDICTED PROBABILITIES FOR CHAPTER 3

Table F.1 Regression model 1.

high food insecurity risk	OR	SE	z	P>z	95% CI	
Urban growth	2.14	0.22	7.57	0.00	1.76	2.61
Ln(σ) Urban growth	0.01	0.41	0.27	0.79	-0.07	0.09
Cut-off 1 Cut-off 2	0.72 2.73	0.25 0.31	2.88 8.84	0.00 0.00	0.23 2.12	1.21 3.33
R^2 = 0.182 n= 869 Log pseudolikelihood =-781						

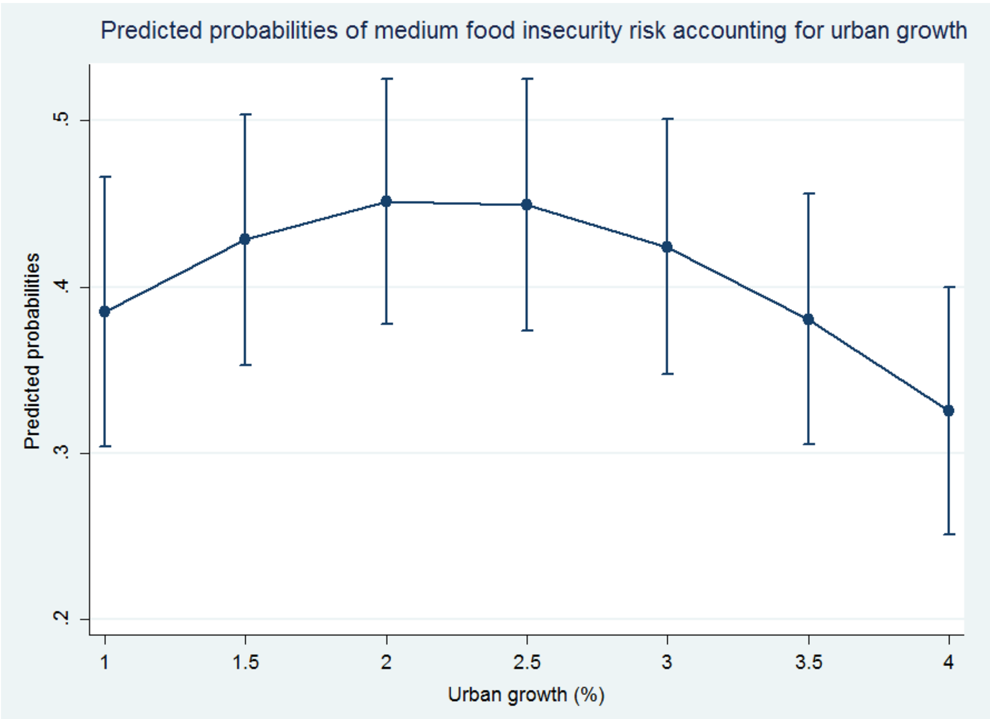

Figure F.1 Predicted probabilities of medium food insecurity risk accounting for urban growth.

Table F.2 Predicted probabilities of food insecurity risk based on model 1.

Predicted probabilities of food insecurity risk						
	high food insecurity risk					
rate of urban growth	Predicted probability	SE	z	P>z	95% CI	
1	0.13	0.02	5.50	0.00	0.08	0.17
1.5	0.17	0.03	6.78	0.00	0.12	0.22
2	0.24	0.03	8.15	0.00	0.18	0.29
2.5	0.31	0.03	9.52	0.00	0.25	0.37
3	0.40	0.04	10.65	0.00	0.32	0.47
3.5	0.49	0.04	11.28	0.00	0.40	0.57
4	0.58	0.05	11.44	0.00	0.48	0.68
	medium food insecurity risk					
rate of urban growth	Predicted probability	SE	z	P>z	95% CI	
1	0.38	0.04	9.29	0.00	0.30	0.47
1.5	0.43	0.04	11.15	0.00	0.35	0.50
2	0.45	0.04	12.00	0.00	0.38	0.52
2.5	0.45	0.04	11.65	0.00	0.37	0.52
3	0.42	0.04	10.84	0.00	0.35	0.50
3.5	0.38	0.04	9.91	0.00	0.31	0.46
4	0.33	0.04	8.58	0.00	0.25	0.40
	low food insecurity risk					
rate of urban growth	Predicted probability	SE	z	P>z	95% CI	
1	0.49	0.05	10.12	0.00	0.39	0.58
1.5	0.40	0.04	9.55	0.00	0.32	0.48
2	0.31	0.04	8.85	0.00	0.24	0.38
2.5	0.24	0.03	7.58	0.00	0.18	0.30
3	0.18	0.03	5.89	0.00	0.12	0.24
3.5	0.13	0.03	4.36	0.00	0.07	0.19
4	0.10	0.03	3.23	0.00	0.04	0.16

Table F.3 Regression model 2.

high food insecurity risk	OR	SE	z	P>z	95% CI	
Urban growth	1.84	0.22	5.21	0.00	1.46	2.32
Development level	0.11	0.06	-3.92	0.00	0.03	0.33
Baseline: less developed	1.00					
Urban growth*development level	0.59	0.10	-3.17	0.00	0.42	0.82
Cut-off 1	-1.58	0.54	-2.95	0.00	-2.63	-0.53
Cut-off 2	1.49	0.42	3.54	0.00	0.66	2.31
R^2 = 0.348 n= 869 Log pseudolikelihood =-622						

Table F.4 Predicted probabilities of food insecurity risk based on model 2.

Predicted probabilities of food insecurity risk						
	high food insecurity risk					
rate of urban growth	Predicted probability	SE	z	P>z	95% CI	
	less developed countries					
1	0.29	0.07	4.39	0.00	0.16	0.43
2.5	0.51	0.05	9.34	0.00	0.40	0.62
4	0.72	0.05	15.64	0.00	0.63	0.81
	more developed countries					
1	0.03	0.01	2.70	0.01	0.01	0.05
2.5	0.07	0.03	2.59	0.01	0.02	0.12
4	0.15	0.06	2.42	0.02	0.03	0.27
	medium food insecurity risk					
rate of urban growth	Predicted probability	SE	z	P>z	95% CI	
	less developed countries					
1	0.61	0.05	11.82	0.00	0.51	0.71
2.5	0.45	0.05	9.40	0.00	0.35	0.54
4	0.26	0.04	6.20	0.00	0.18	0.34
	more developed countries					
1	0.33	0.04	8.28	0.00	0.25	0.40
2.5	0.49	0.05	9.95	0.00	0.39	0.58
4	0.59	0.05	11.65	0.00	0.49	0.69
	low food insecurity risk					
rate of urban growth	Predicted probability	SE	z	P>z	95% CI	
	less developed countries					
1	0.10	0.04	2.34	0.02	0.02	0.18
2.5	0.04	0.02	2.43	0.02	0.01	0.08
4	0.02	0.01	2.24	0.03	0.00	0.03
	more developed countries					
1	0.64	0.04	15.51	0.00	0.56	0.73
2.5	0.44	0.06	7.87	0.00	0.33	0.55
4	0.26	0.06	4.13	0.00	0.14	0.38

Table F.5 Regression model 3

high food insecurity risk	OR	SE	z	P>z	95% CIs	
Urban growth	2.05	0.29	5.01	0.00	1.55	2.71
Development level (more developed)	0.17	0.11	-2.79	0.01	0.05	0.59
Urban growth*development level	0.54	0.12	-2.71	0.01	0.35	0.84
Agricultural land	0.61	0.23	-1.34	0.18	0.29	1.26
Baseline: low proportion	1.00					
FDI	1.05	0.03	1.92	0.06	1.00	1.10
Internet usage	0.98	0.01	-2.81	0.01	0.96	0.99
Water production	0.99	0.00	-2.01	0.05	0.99	1.00
Ln(σ)						
Agricultural land (high proportion)	0.09	0.22	0.39	0.70	-0.35	0.52
Internet usage	0.0003	0.00	0.06	0.95	-0.01	0.01
Cut-off 1	-1.70	0.57	-2.98	0.00	-2.82	-0.58
Cut-off 2	1.50	0.48	3.14	0.00	0.56	2.43
R^2 = 0.375						
n= 719						
Log pseudolikelihood =-493						

Table F.6 Predicted probabilities of food insecurity risk based on model 3.

Predicted probabilities of food insecurity risk						
	high food insecurity risk					
rate of urban growth	Predicted probability	SE	z	P>z	95% CI	
less developed countries						
1	0.26	0.06	4.06	0.00	0.13	0.38
2.5	0.48	0.06	8.49	0.00	0.37	0.59
4	0.71	0.06	12.51	0.00	0.60	0.82
more developed countries						
1	0.03	0.01	2.64	0.01	0.01	0.05
2.5	0.08	0.03	2.47	0.01	0.02	0.14
4	0.17	0.07	2.37	0.02	0.03	0.31
	medium food insecurity risk					
rate of urban growth	Predicted	SE	z	P>z	95% CI	
less developed countries						
1	0.61	0.05	11.25	0.00	0.50	0.71
2.5	0.46	0.05	9.70	0.00	0.37	0.56
4	0.27	0.05	5.47	0.00	0.17	0.36
more developed countries						
1	0.29	0.04	7.51	0.00	0.22	0.37
2.5	0.45	0.05	8.83	0.00	0.35	0.55
4	0.55	0.05	10.48	0.00	0.44	0.65
	low food insecurity risk					
rate of urban growth	Predicted	SE	z	P>z	95% CI	
less developed countries						
1	0.14	0.06	2.24	0.03	0.02	0.25
2.5	0.06	0.03	2.07	0.04	0.00	0.11
4	0.02	0.01	1.70	0.09	0.00	0.05
more developed countries						
1	0.68	0.04	15.91	0.00	0.59	0.76
2.5	0.48	0.06	7.41	0.00	0.35	0.60
4	0.28	0.08	3.52	0.00	0.13	0.44

Table F.7 Regression model 4

high food insecurity risk	OR	SE	z	P>z	95% CIs	
Urban growth	2.11	0.33	4.77	0.00	1.55	2.87
Mean education	0.86	0.08	-1.61	0.11	0.71	1.03
Urban growth*mean education	0.92	0.02	-4.71	0.00	0.89	0.96
Ln(σ)						
Mean education	-0.09	0.04	-2.58	0.01	-0.16	-0.02
Cut-off 1	-1.36	0.87	-1.57	0.12	-3.06	0.34
Cut-off 2	0.09	0.60	0.15	0.88	-1.09	1.27
R^2 = 0.365						
n= 869						
Log pseudolikelihood =-607						

Table F.8 Regression model 5

high food insecurity risk	OR	SE	z	P>z	95% CIs	
Urban growth	1.33	0.17	2.16	0.03	1.03	1.71
Mean education	0.95	0.05	-0.94	0.35	0.86	1.05
Urban growth*mean education	0.97	0.01	-2.20	0.03	0.94	1.00
Life expectancy	0.92	0.03	-2.49	0.01	0.87	0.98
Agricultural land	0.67	0.10	-2.73	0.01	0.50	0.89
Baseline: low proportion	1.00					
Trade	0.998	0.00	-1.48	0.14	0.99	1.00
FDI	1.02	0.01	1.92	0.06	1.00	1.04
Disasters	1.01	0.00	1.55	0.12	1.00	1.01
TFR	1.22	0.10	2.54	0.01	1.05	1.42
Water production	0.999	0.00	-0.75	0.46	1.00	1.00
Ln(σ)						
Agricultural land	-0.08	0.19	-0.43	0.66	-0.44	0.28
Mean education	-0.14	0.04	-3.52	0.00	-0.21	-0.06
FDI	-0.02	0.01	-1.40	0.16	-0.05	0.01
Cut-off 1	-5.93	2.55	-2.32	0.02	-10.93	-0.93
Cut-off 2	-4.48	2.14	-2.09	0.04	-8.69	-0.28
R^2 = 0.574						
n= 717						
Log pseudolikelihood =-335						

Table F.9 Predicted probabilities of food insecurity risk based on model 5.

Predicted probabilities of food insecurity risk						
	high food insecurity risk					
rate of urban growth	Predicted probability	SE	z	P>z	95% CI	
		low level of education				
1	0.30	0.06	5.41	0.00	0.19	0.41
2.5	0.39	0.04	10.52	0.00	0.32	0.47
4	0.51	0.08	6.34	0.00	0.35	0.66
		high level of education				
1	0.24	0.04	6.37	0.00	0.16	0.31
2.5	0.31	0.04	8.21	0.00	0.24	0.38
4	0.41	0.11	3.85	0.00	0.20	0.62
	medium food insecurity risk					
rate of urban growth	Predicted probability	SE	z	P>z	95% CI	
		low level of education				
1	0.38	0.05	8.28	0.00	0.29	0.47
2.5	0.40	0.04	9.96	0.00	0.32	0.48
4	0.38	0.05	7.47	0.00	0.28	0.48
		high level of education				
1	0.38	0.03	11.77	0.00	0.31	0.44
2.5	0.46	0.05	8.86	0.00	0.36	0.56
4	0.49	0.04	11.45	0.00	0.40	0.57
	low food insecurity risk					
rate of urban growth	Predicted probability	SE	z	P>z	95% CI	
		low level of education				
1	0.32	0.08	4.18	0.00	0.17	0.47
2.5	0.20	0.04	4.84	0.00	0.12	0.29
4	0.12	0.05	2.54	0.01	0.03	0.21
		high level of education				
1	0.39	0.03	13.14	0.00	0.33	0.45
2.5	0.23	0.06	3.56	0.00	0.10	0.36
4	0.10	0.09	1.18	0.24	0.07	0.28

Table F.10 Results of the test for interaction effects (urban growth and categorical level of development).

high food insecurity risk	OR	SE	z	P>z	95% CIs	
Urban growth	0.78	0.25	-0.77	0.44	0.41	1.47
Development level	8.46	4.37	4.13	0.00	3.07	23.29
Urban growth*development	1.19	0.17	1.22	0.22	0.90	1.58
Ln(σ)						
Level of development	-0.01	0.10	-0.07	0.94	-0.21	0.20
Cut-off 1	4.17	0.94	4.44	0.00	2.33	6.00
Cut-off 2	7.87	1.86	4.22	0.00	4.22	11.52
R^2 = 0.500						
n= 869						
Log pseudolikelihood =-477						

Table F.11 Results of the test for interaction effects (developing countries only).

high food insecurity risk	OR	SE	z	P>z	95% CIs	
Urban growth	1.02	0.01	2.30	0.02	1.00	1.04
Development level	1.04	0.01	5.34	0.00	1.03	1.06
Urban growth* development	0.995	0.00	-2.10	0.04	0.99	1.00
Ln(σ)						
Level of development	-1.35	0.03	-49.57	0.00	-1.40	-1.30
Cut-off 1	0.11	0.29	3.66	0.00	0.05	0.16
Cut-off 2	0.16	0.03	5.27	0.00	0.10	0.22
R^2 = 0.366						
n= 449						
Log pseudolikelihood =-231						

Table F.12 Predicted probabilities of food insecurity risk based on results in Table F.11.

Predicted probabilities of high food insecurity risk						
rate of urban growth	Predicted probability	SE	z	P>z	95% CI	
countries with low development						
1	0.04	0.02	2.33	0.02	0.01	0.08
3	0.39	0.10	3.98	0.00	0.20	0.58
5	0.87	0.03	30.95	0.00	0.82	0.93
countries medium development						
1	0.08	0.03	2.80	0.01	0.02	0.14
3	0.37	0.07	5.32	0.00	0.23	0.50
5	0.78	0.13	6.03	0.00	0.53	1.03

APPENDIX G CLASSIFICATION OF WATER SOURCES

Improved sources of drinking-water:

- Piped water into dwelling
- Piped water to yard/plot
- Public tap or standpipe
- Tubewell or borehole
- Protected dug well
- Protected spring
- Rainwater

Unimproved sources of drinking-water:

- Unprotected spring
- Unprotected dug well
- Cart with small tank/drum
- Tanker-truck
- Surface water
- Bottled water

APPENDIX H STUDY SAMPLE IN CHAPTER 4

Table H.1 Initial sample of households from DHS across 19 countries.

Country	DHS-code	n	% of sample	Inclusion in LDC list
Bangladesh	BD5	10,400	5.15	1975
Benin	BJ5	17,511	8.68	1971
Burundi	BU6	8,596	4.26	1971
Congo Democratic Republic	CD5	8,886	4.40	1991
Ethiopia	ET6	16,702	8.28	1971
Liberia	LB5	6,824	3.38	1990
Lesotho	LS5	9,391	4.65	1971
Mali	ML5	12,998	6.44	1971
Maldives	MV5	6,443	3.19	1971
Malawi	MW5	24,825	12.30	1971
Nepal	NP6	10,826	5.37	1971
Rwanda	RW6	12,540	6.21	1971
Sierra Leone	SL5	7,284	3.61	1982
Senegal	SN6	7,902	3.92	2000
Sao Tome and Principe	ST5	3,536	1.75	1982
Timor Leste	TL5	11,463	5.68	2003
Tanzania	TZ5	9,623	4.77	1971
Uganda	UG5	8,870	4.40	1971
Zambia	ZM5	7,164	3.55	1991
Total:		**201,784**	100.00	

Notes: Author’s calculations based on the DHS data and United Nations (2008).

APPENDIX I RESULTS OF ANOVA TESTS IN CHAPTER 4

Table I.1 Cross-tabulation of household education by access to safe drinkig water (SDW) and place of residence.

Access to SDW	Household education					
		Mean	Median	SE	F-value	Bartlett's χ^2
Able to access SDW	rural	2.84	2.43	2.36	(18,293)***	(9,200)***
	urban	5.01	4.57	3.46		
Unable to access SDW	rural	2.06	1.60	2.05	(3,813)***	(3,700)***
	urban	3.73	3.11	3.26		

Note: *** p≤0.01.

Table I.2 Cross-tabulation of household education by access to improved water source and type of residence.

Access to SDW	Household education					
	Type of residence	Mean	Median	SE	F-value	Bartlett's χ^2
Able to access SDW	Large city	5.38	5.00	3.48	(2,291)***	(3,700)***
	Small city	4.45	4.00	3.23		
	Town	4.22	3.71	3.25		
	Countryside	2.91	2.50	2.35		
Unable to access SDW	Large city	5.21	4.50	3.50	(653)***	(1,200)***
	Small city	3.06	2.50	2.70		
	Town	2.57	2.00	2.66		
	Countryside	2.23	1.86	2.09		

Note: *** p≤0.01.

APPENDIX J FULL REGRESSION MODELS AND PREDICTED ODDS (CHAPTER 4)

Table J.1 Results of the empty multilevel model.

Access to SDW	OR	SE	z	P>z	95% CIs	
Constant	2.68	0.58	4.54	0.00	1.75	4.10
Country effects	0.89	0.29			0.47	1.69
n= 200,507						
Log likelihood = -113,105						
LR test vs. logistic regression: χ^2 = (20,745)***						

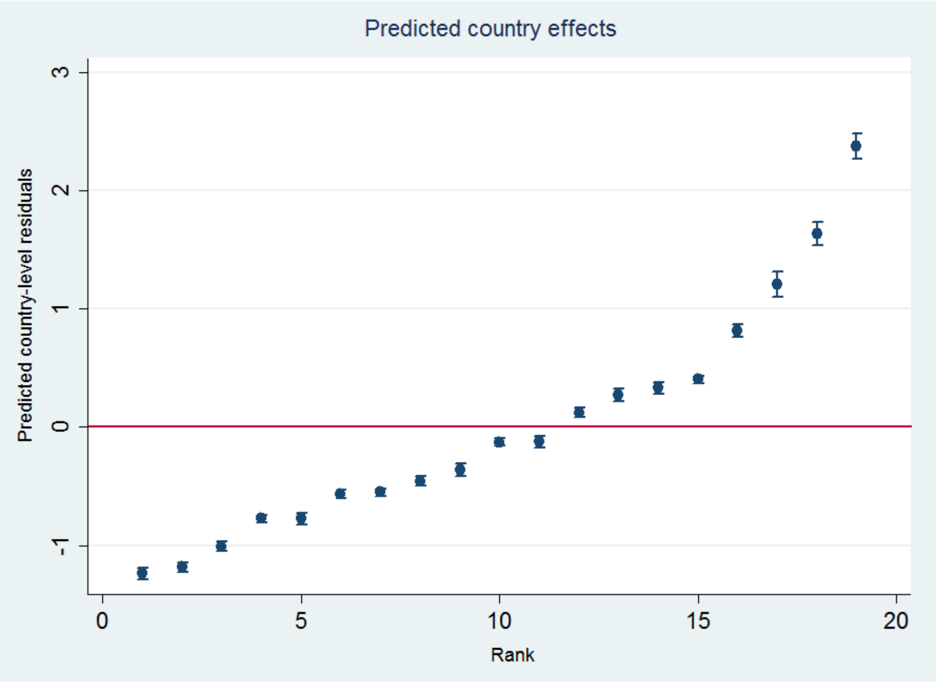

Figure J.1 Predicted country-level effects.

Table J.2 Results of the unadjusted multilevel logistic regression (Model 1).

Access to SDW	OR	SE	z	P>z	95% CIs	
Urban	4.65	0.07	107.20	0.00	4.52	4.78
Baseline: rural	1.00					
Constant	1.87	0.44	2.65	0.00	1.18	2.98
Country-level variance	1.07	0.34			0.56	2.02
n= 200,507						
Log likelihood =-106,207						
LR test vs. logistic regression: $\chi^2 = 24{,}693$						

Table J.3 Results of logistic regression including place of residence, household education and interaction between both variables (Model 2).

Access to SDW	OR	SE	z	P>z	95% CIs	
Urban	3.30	0.07	52.46	0.00	3.15	3.44
Baseline: rural	1.00					
Household education	1.13	0.00	38.33	0.00	1.12	1.13
Household education*urban	1.02	0.01	3.72	0.00	1.01	1.03
Constant	1.40	0.32	1.47	1.41	0.89	2.19
Country-level variance	0.99	0.32			0.52	1.87
n= 200,507						
Log likelihood = -100,910						
LR test vs. logistic regression: $\chi^2 = 21{,}327$						

Table J.4 Predicted odds of access to SDW based on interaction terms in Model 2.

PLACE OF RESIDENCE (urban vs. rural)						
	URBAN					
Mean HH education (years)	Predicted odds	SE	z	P>z	95% CI	
0	5.06	0.32	4.38	0.00	0.77	2.03
2	6.41	1.47	4.37	0.00	3.54	9.29
4	8.13	1.86	4.37	0.00	4.48	11.77
6	10.30	2.36	4.37	0.00	5.68	14.92
8	13.05	2.99	4.37	0.00	7.20	18.91
PLACE OF RESIDENCE (urban vs. rural)						
	RURAL					
Mean HH education (years)	Predicted odds	SE	z	P>z	95% CI	
0	1.40	0.32	4.38	0.00	0.77	2.03
2	1.77	0.41	4.38	0.00	0.98	2.57
4	2.25	0.51	4.37	0.00	1.24	3.25
6	2.85	0.65	4.37	0.00	1.57	4.13
8	3.61	0.83	4.37	0.00	1.99	5.23

Table J.5 Results of the unadjusted model with type of residence as independent variable (Model 3).

Access to SDW	**OR**	**SE**	**z**	**P>z**	**95% CIs**	
Large city	12.86	0.46	71.68	0.00	11.99	13.79
Small city	8.14	0.34	49.06	0.00	7.49	8.85
Town	3.41	0.09	48.09	0.00	3.25	3.59
Baseline: countryside	1.00					
Constant	1.06	0.44	0.15	0.88	0.47	2.39
Country-level variance	1.54	0.44			0.47	2.39
n= 96,447						
Log likelihood = -50,709						
LR test vs. logistic regression: χ^2 = 17,563						

Table J.6 Results of the model with interaction effects and confounding variables (Model 4).

Access to SDW	**OR**	**SE**	**z**	**P>z**	**95% CIs**	
Micro-level factors						
Large city	9.93	0.63	36.09	0.00	8.77	11.25
Small city	4.57	0.30	22.81	0.00	4.01	5.20
Town	2.04	0.08	18.20	0.00	1.89	2.20
baseline: countryside	1.00					
Household education	1.09	0.01	17.85	0.00	1.08	1.10
Household education*large city	0.94	0.01	-5.68	0.00	0.92	0.96
Household education*small city	1.05	0.02	3.17	0.00	1.02	1.08
Household education*town	1.07	0.01	7.55	0.00	1.05	1.09
Number of household members						
1-4	0.77	0.03	-6.44	0.00	0.71	0.84
5-7	0.85	0.03	-4.05	0.00	0.79	0.92
8-10	0.92	0.04	-1.94	0.05	0.84	1.00
baseline: more than 10	1.00					
Female head of household	1.22	0.02	10.12	0.00	1.17	1.27
baseline: male	1.00					
Household wall material						
finished	1.72	0.06	15.79	0.00	1.61	1.84
rudimentary	1.71	0.04	20.94	0.00	1.63	1.80
baseline: natural	1.00					
Time to fetch water						
between 10 and 30 min	0.60	0.01	-23.49	0.00	0.58	0.63
more than 30 min	0.53	0.01	-27.64	0.00	0.50	0.55
baseline: less than 10 min	1.00					
Constant	1.23	0.51	0.50	0.62	0.50	0.55
Country-level variance	1.51	0.71			0.60	3.81
n= 92,133						
Log likelihood = -47,015						
LR test vs. logistic regression: χ^2 = (12,786)***						

Table J.7 Predicted odds of access to SDW based on interaction terms in Model 4.

TYPE OF RESIDENCE						
	LARGE CITY					
HH education (years)	Predicted odds	SE	z	P>z	95% CI	
0	8.38	3.45	2.43	0.02	1.62	15.14
2	9.92	4.08	2.43	0.02	2.78	17.91
4	11.74	4.83	2.43	0.02	2.28	21.20
6	13.89	5.71	2.43	0.02	2.70	25.09
8	16.44	6.76	2.43	0.02	3.19	29.70
	SMALL CITY					
HH education (years)	Predicted odds	SE	z	P>z	95% CI	
0	6.78	2.81	2.42	0.02	1.29	12.28
2	8.03	3.32	2.42	0.02	1.53	14.53
4	9.50	3.92	2.42	0.02	1.81	17.19
6	11.25	4.64	2.42	0.02	2.15	20.34
8	13.31	5.50	2.42	0.02	2.54	24.08
	TOWN					
HH education (years)	Predicted odds	SE	z	P>z	95% CI	
0	3.08	1.27	2.43	0.02	0.60	5.56
2	3.64	1.50	2.44	0.02	0.71	6.58
4	4.31	1.77	2.44	0.02	0.84	7.78
6	5.10	2.09	2.44	0.02	1.00	9.21
8	6.04	2.48	2.43	0.02	1.18	10.90
	COUNTRYSIDE					
HH education (years)	Predicted odds	SE	z	P>z	95% CI	
0	0.97	0.40	2.44	0.02	0.19	1.75
2	1.15	0.47	2.44	0.02	0.23	2.08
4	1.36	0.56	2.44	0.02	0.27	2.46
6	1.61	0.66	2.44	0.02	0.32	2.91
8	1.91	0.78	2.44	0.02	0.37	3.44

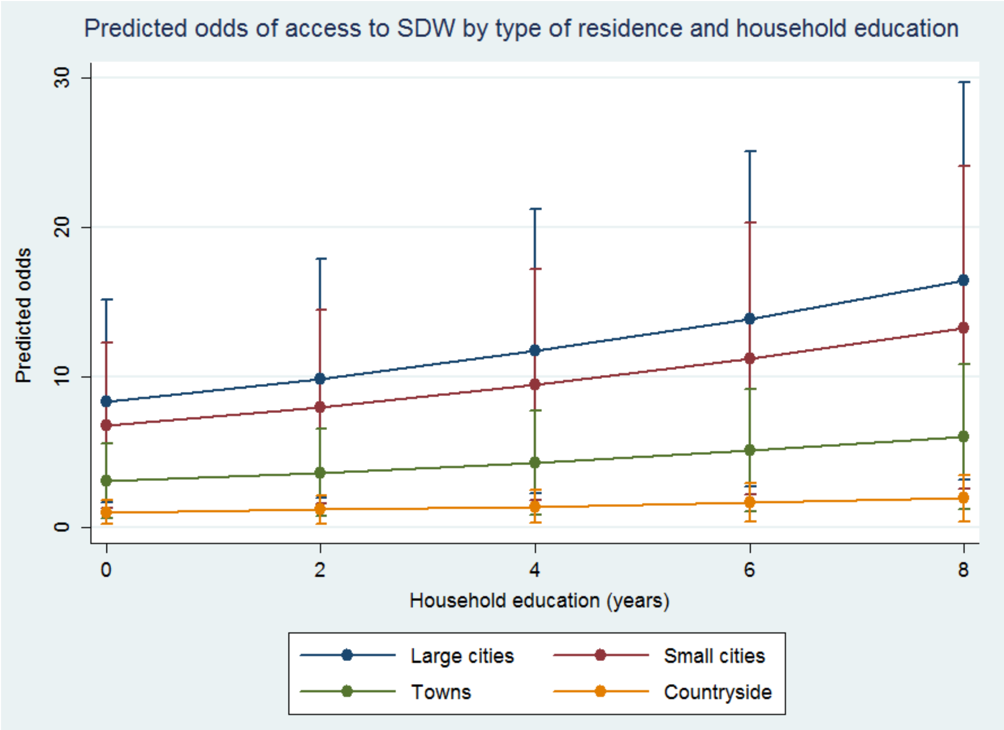

Figure J.2 Predicted odds of access to SDW accounting for household education and type of residence (Model 4).

Table J.8 Output of logistic regression model testing for effect of urban growth (Model 5).

Access to SDW	OR	SE	z	P>z	95% CIs	
Urban growth	0.73	0.00	-48.71	0.00	0.72	0.74
Constant	8.23	0.22	77.80	0.00	7.80	8.68
n= 200,507						
Log likelihood =-122,291						

Table J.9 Multilevel regression model with interaction effects and confounding variables (Model 6).

Access to SDW	OR	SE		P>z	95% CIs	
Urban	3.27	0.11	35.66	0.00	3.06	3.49
Baseline: rural	1.00					
Mean household education	1.18	0.03	6.75	0.00	1.12	1.23
Mean household education*Urban	0.91	0.01	-14.77	0.00	0.90	0.92
Number of household members	1.01	0.00	4.46	0.00	1.01	1.02
Sex of the head of household	1.18	0.02	10.20	0.00	1.14	1.22
baseline: male	1.00					
Household has electricity	2.40	0.06	34.14	0.00	2.28	2.53
baseline: no electricity	1.00					
Household has bank account	1.12	0.03	5.16	0.00	1.07	1.17
baseline: no bank account	1.00					
Time to fetch water						
between 10 and 30 min	0.46	0.01	-40.77	0.00	0.44	0.47
more than 30 min	0.34	0.01	-54.82	0.00	0.33	0.36
baseline: less than 10 min	1.00					
Contextual factors						
Urban growth	2.34	0.50	3.96	0.00	1.54	3.57
Urban population in slums	1.02	0.01	1.71	0.09	1.00	1.03
Population growth	1.02	0.01	1.71	0.09	1.00	1.03
Political stability	1.02	0.01	1.71	0.09	1.00	1.03
Expenditure on education	1.13	0.05	2.51	0.01	1.03	1.23
Roads network	1.02	0.01	2.79	0.01	1.01	1.04
Cross-level interactions						
Household education*Urban growth	0.95	0.01	-9.42	0.00	0.93	0.96
Household education*Population in slums	1.00	0.00	22.65	0.00	1.00	1.00
Constant	2.55	2.15	1.11	0.27	0.49	13.31
Country-level variance	0.20	0.08			0.09	0.43
n= 132,540						
Log likelihood = -66,705						
LR test vs. logistic regression: $\chi^2 = 4,327$ $p>=\chi^2 < 0.01$						

Table J.10 Predicted odds for interaction effects based on Model 6.

Mean HH education (years)	Margin (predicted odds)	SE	z	P>z	95% CI	
URBAN GROWTH (at mean value)						
0	2.99	0.64	4.64	0.00	1.72	4.25
2	3.92	0.82	4.77	0.00	2.31	5.53
4	5.14	1.07	4.81	0.00	3.04	7.23
6	6.73	1.42	4.76	0.00	3.96	9.51
8	8.83	1.91	4.62	0.00	5.08	12.58
PROPORTION OF URBAN POPULATION IN SLUMS (at mean value)						
Mean HH education (years)	Margin (predicted odds)	SE	z	P>z	95% CI	
0	2.93	0.64	4.57	0.00	1.67	4.19
2	3.84	0.82	4.71	0.00	2.24	5.44
4	5.04	1.06	4.76	0.00	2.96	7.12
6	6.61	1.40	4.72	0.00	3.86	9.35
8	8.67	1.89	4.59	0.00	4.97	12.36

APPENDIX K SENSITIVITY ANALYSIS FOR MODELS IN CHAPTER 4

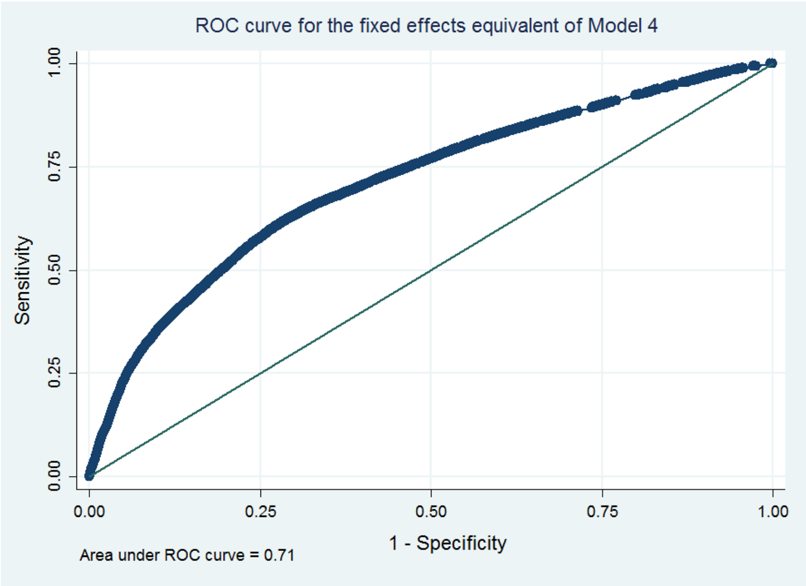

Figure K.1 ROC curve for the fixed effects equivalent of Model 4.

Note: According to the results of the classification table 68.06% of the cases were correctly predicted. Sensitivity analysis is based on the equivalent fixed effect model as this option is not available for multilevel models.

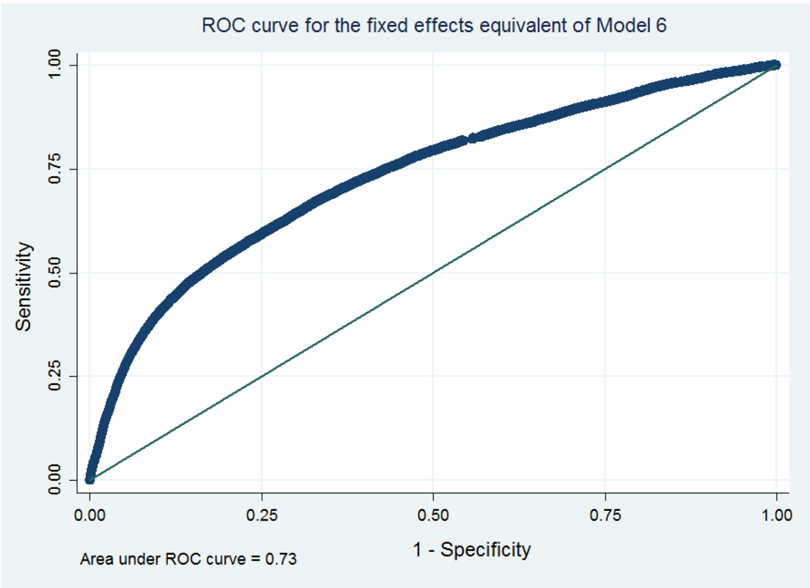

Figure K.2 ROC curve for the fixed effects equivalent of Model 6.

Note: According to the results of the classification table 71.07% of the cases were correctly predicted. Sensitivity analysis is based on the equivalent fixed effect model as this option is not available for multilevel models.

APPENDIX L DISTRIBUTION OF VARIABLES INCLUDED IN PCA (CHAPTER 5)

Table L.1 Distribution of asset variables (Burkina Faso).

Burkina Faso	frequency	% distribution
has electricity		
yes	1,170	36.80
no	2,009	63.20
toilet type		
no toilet	792	25.01
shared other	1,211	63.25
shared flush	16	63.75
private other	1,029	96.24
private flush	119	100.00
wall material		
natural	797	25.10
rudimentary	308	9.70
finished	2,070	65.20
roof material		
natural	424	13.38
rudimentary	49	1.55
finished	2,695	85.07
floor material		
natural	625	19.68
rudimentary	.	.
finished	2,551	80.32
has radio		
yes	2,431	76.47
no	748	23.53
has television		
yes	1,200	37.75
no	1,979	62.25
has refrigerator		
yes	312	9.82
no	2,866	90.18
has motorcycle/ scooter		
yes	1,730	54.42
no	1,449	45.58
has car/track		
yes	148	4.66
no	3,031	95.34
mother's education		
no education	1,845	56.89
incomplete primary	575	17.73
complete primary	217	6.69
incomplete secondary	532	16.40
complete secondary	27	0.83
higher	47	1.45
father's education		
no education	1,679	54.42
incomplete primary	516	16.73
complete primary	209	6.77
incomplete secondary	571	18.51
complete secondary	35	1.13
higher	75	2.43

Table L.2 Distribution of asset variables (Burundi).

Burundi	frequency	% distribution
has electricity		
yes	604	45.41
no	726	54.59
toilet type		
no toilet	28	2.10
shared other	568	42.67
shared flush	70	5.26
private other	443	33.28
private flush	222	16.68
wall material		
natural	15	1.13
rudimentary	230	17.32
finished	1,083	81.55
roof material		
natural	54	4.06
rudimentary	6	0.45
finished	1,271	95.49
floor material		
natural	519	39.29
rudimentary	.	.
finished	802	60.71
has radio		
yes	1,023	76.80
no	309	23.20
has television		
yes	455	34.29
no	872	65.71
has refrigerator		
yes	214	16.09
no	1,116	83.91
has motorcycle/ scooter		
yes	70	5.26
no	1,261	94.74
has car/track		
yes	112	8.41
no	1,219	91.59
mother's education		
no education	249	18.30
incomplete primary	343	25.20
complete primary	234	17.19
incomplete secondary	414	30.42
complete secondary	29	2.13
higher	92	6.76
father's education	196	15.68
no education	214	17.12
incomplete primary	307	24.56
complete primary	339	27.12
incomplete secondary	22	1.76
complete secondary	172	13.76
higher		

Table L.3 Distribution of asset variables (DRC).

DRC	frequency	% distribution
has electricity		
yes	1,259	35.92
no	2,246	64.08
toilet type		
no toilet	144	4.25
shared other	1,686	49.73
shared flush	266	7.85
private other	1,206	35.58
private flush	88	2.60
wall material		
natural	.	.
rudimentary	.	.
finished	.	.
roof material		
natural	891	25.43
rudimentary	44	1.26
finished	2,569	73.32
floor material		
natural	1,850	52.75
rudimentary	81	2.31
finished	1,576	44.94
has radio		
yes	2,230	63.62
no	1,275	36.38
has television		
yes	1,189	33.91
no	2,317	66.09
has refrigerator		
yes	312	8.91
no	3,188	91.09
has motorcycle/ scooter		
yes	121	3.45
no	3,390	96.55
has car/track		
yes	100	2.85
no	3,411	97.15
mother's education		
no education	305	8.53
incomplete primary	812	22.71
complete primary	325	9.09
incomplete secondary	1,689	47.24
complete secondary	357	9.99
higher	87	2.43
father's education		
no education	119	3.62
incomplete primary	246	7.49
complete primary	142	4.32
incomplete secondary	1,339	40.75
complete secondary	891	27.12
higher	549	16.71

Table L.4 Distribution of asset variables (Mozambique).

Mozambique	frequency	% distribution
has electricity		
yes	2,090	59.04
no	1,450	40.96
toilet type		
no toilet	427	12.06
shared other	511	14.44
shared flush	48	1.36
private other	1,992	56.27
private flush	562	15.88
wall material		
natural	515	14.61
rudimentary	1,163	32.99
finished	1,847	52.40
roof material		
natural	970	27.56
rudimentary	.	.
finished	2,549	72.44
floor material		
natural	1,014	28.67
rudimentary	393	11.11
finished	2,130	60.22
has radio		
yes	2,138	60.40
no	1,402	39.60
has television		
yes	1,978	55.88
no	1,562	44.12
has refrigerator		
yes	1,268	35.82
no	2,272	64.18
has motorcycle/ scooter		
yes	246	6.95
no	3,294	93.05
has car/track		
yes	332	9.38
no	3,208	90.62
mother's education		
no education	504	13.97
incomplete primary	1,499	41.55
complete primary	489	13.55
incomplete secondary	874	24.22
complete secondary	161	4.46
higher	81	2.25
father's education		
no education	256	8.71
incomplete primary	865	29.44
complete primary	425	14.47
incomplete secondary	891	30.33
complete secondary	333	11.33
higher	168	5.72

Table L.5 Distribution of asset variables (Nepal).

Nepal	frequency	% distribution
has electricity		
yes	937	92.41
no	77	7.59
toilet type		
no toilet	216	21.30
shared other	50	4.93
shared flush	292	28.80
private other	59	5.82
private flush	397	39.15
wall material		
natural	77	7.68
rudimentary	229	22.85
finished	696	69.46
roof material		
natural	53	5.23
rudimentary	6	0.59
finished	954	94.18
floor material		
natural	407	40.14
rudimentary	3	0.30
finished	604	59.57
has radio		
yes	449	44.28
no	565	55.72
has television		
yes	717	70.71
no	297	29.29
has refrigerator		
yes	193	19.03
no	821	80.97
has motorcycle/ scooter		
yes	198	19.53
no	816	80.47
has car/track		
yes	30	2.96
no	984	97.04
mother's education		
no education	317	29.06
incomplete primary	134	12.28
complete primary	62	5.68
incomplete secondary	278	25.48
complete secondary	162	14.85
higher	138	12.65
father's education		
no education	115	10.59
incomplete primary	137	12.62
complete primary	79	7.27
incomplete secondary	307	28.27
complete secondary	203	18.69
higher	245	22.56

Table L.6 Distribution of asset variables (Niger).

Niger	frequency	% distribution
has electricity		
yes	1,278	50.31
no	1,262	49.69
toilet type		
no toilet	518	20.49
shared other	870	34.41
shared flush	21	0.83
private other	915	36.19
private flush	204	8.07
wall material		
natural	.	.
rudimentary	.	.
finished	.	.
roof material		
natural	.	.
rudimentary	.	.
finished	.	.
floor material		
natural	1,007	39.72
rudimentary	.	.
finished	1,528	60.28
has radio		
yes	1,944	76.60
no	594	23.40
has television		
yes	1,009	39.77
no	1,528	60.23
has refrigerator		
yes	458	18.06
no	2,078	81.94
has motorcycle/ scooter		
yes	524	20.64
no	2,015	79.36
has car/track		
yes	335	13.19
no	2,204	86.81
mother's education		
no education	1,625	62.33
incomplete primary	462	17.72
complete primary	86	3.30
incomplete secondary	369	14.15
complete secondary	39	1.50
higher	26	1.00
father's education		
no education	1,521	61.13
incomplete primary	287	11.54
complete primary	76	3.05
incomplete secondary	425	17.08
complete secondary	45	1.81
higher	134	5.39

Table L.7 Distribution of asset variables (Rwanda).

Rwanda	frequency	% distribution
has electricity		
yes	546	45.12
no	664	54.88
toilet type		
no toilet	8	0.67
shared other	527	44.06
shared flush	.	.
private other	594	49.67
private flush	67	5.60
wall material		
natural	35	2.92
rudimentary	332	27.69
finished	832	69.39
roof material		
natural	13	1.07
rudimentary	1	0.08
finished	1,196	98.84
floor material		
natural	496	41.40
rudimentary	.	.
finished	702	58.60
has radio		
yes	894	73.88
no	316	26.12
has television		
yes	384	31.74
no	826	68.26
has refrigerator		
yes	107	8.84
no	1,103	91.16
has motorcycle/ scooter		
yes	21	1.74
no	1,189	98.26
has car/track		
yes	75	6.20
no	1,135	93.80
mother's education		
no education	106	8.65
incomplete primary	566	46.20
complete primary	170	13.88
incomplete secondary	209	17.06
complete secondary	87	7.10
higher	87	7.10
father's education		
no education	99	9.07
incomplete primary	435	39.84
complete primary	184	16.85
incomplete secondary	198	18.13
complete secondary	74	6.78
higher	102	9.34

Table L.8 Distribution of asset variables (Senegal).

Senegal	frequency	% distribution
has electricity		
yes	2,924	83.02
no	598	16.98
toilet type		
no toilet	102	2.90
shared other	594	16.88
shared flush	239	6.79
private other	1,743	49.53
private flush	841	23.90
wall material		
natural	426	12.12
rudimentary	72	2.05
finished	3,017	85.83
roof material		
natural	217	6.18
rudimentary	33	0.94
finished	3,263	92.88
floor material		
natural	673	19.11
rudimentary	3	0.09
finished	2,846	80.81
has radio		
yes	2,808	79.73
no	714	20.27
has television		
yes	2,736	77.68
no	786	22.32
has refrigerator		
yes	1,117	31.71
no	2,405	68.29
has motorcycle/ scooter		
yes	638	18.11
no	2,884	81.89
has car/track		
yes	149	4.23
no	3,373	95.77
mother's education		
no education	1,956	53.66
incomplete primary	955	26.20
complete primary	175	4.80
incomplete secondary	484	13.28
complete secondary	37	1.02
higher	38	1.04
father's education		
no education	1,852	60.82
incomplete primary	445	14.61
complete primary	125	4.11
incomplete secondary	367	12.05
complete secondary	93	3.05
higher	163	5.35

Table L.9 Distribution of asset variables (Sierra Leone).

Sierra Leone	frequency	% distribution
has electricity		
yes	521	27.26
no	1,390	72.74
toilet type		
no toilet	139	7.45
shared other	1,223	65.58
shared flush	55	2.95
private other	297	15.92
private flush	151	8.10
wall material		
natural	635	33.79
rudimentary	175	9.31
finished	1,069	56.89
roof material		
natural	102	5.35
rudimentary	160	8.39
finished	1,645	86.26
floor material		
natural	560	29.38
rudimentary	4	0.21
finished	1,342	70.41
has radio		
yes	1,463	76.64
no	446	23.36
has television		
yes	451	23.62
no	1,458	76.38
has refrigerator		
yes	260	13.63
no	1,648	86.37
has motorcycle/ scooter		
yes	156	8.17
no	1,754	91.83
has car/track		
yes	69	3.61
no	1,841	96.39
mother's education		
no education	1,004	52.29
incomplete primary	236	12.29
complete primary	95	4.95
incomplete secondary	431	22.45
complete secondary	85	4.43
higher	69	3.59
father's education		
no education	660	41.75
incomplete primary	117	7.40
complete primary	73	4.62
incomplete secondary	419	26.50
complete secondary	129	8.16
higher	183	11.57

Table L.10 Distribution of asset variables (Zambia).

Zambia	frequency	% distribution
has electricity		
yes	731	36.48
no	1,273	63.52
toilet type		
no toilet	81	4.08
shared other	860	43.28
shared flush	111	5.59
private other	573	28.84
private flush	362	18.22
wall material		
natural	192	9.73
rudimentary	63	3.19
finished	1,719	87.08
roof material		
natural	397	19.83
rudimentary	1	0.05
finished	1,604	80.12
floor material		
natural	547	27.34
rudimentary	.	.
finished	1,454	72.66
has radio		
yes	1,432	71.46
no	572	28.54
has television		
yes	1,024	51.12
no	979	48.88
has refrigerator		
yes	536	26.85
no	1,460	73.15
has motorcycle/ scooter		
yes	8	0.40
no	1,996	99.60
has car/track		
yes	99	4.94
no	1,905	95.06
mother's education		
no education	99	4.78
incomplete primary	538	25.95
complete primary	458	22.09
incomplete secondary	671	32.37
complete secondary	173	8.35
higher	134	6.46
father's education		
no education	39	2.14
incomplete primary	203	11.16
complete primary	310	17.04
incomplete secondary	674	37.05
complete secondary	320	17.59
higher	273	15.01

APPENDIX M FULL REGRESSION MODELS FOR CHAPTER 5 - OUTCOME VARIABLE: UNDERWEIGHT

Table M.1 Complete regression results for most rapidly urbanising countries.

Child underweight	**OR**	**SE**	**z**	**P>z**	**95% CIs**	
variable						
Household assets						
Poorer	0.65	0.09	-2.98	0.00	0.50	0.86
Middle	0.58	0.09	-3.67	0.00	0.44	0.78
Richer	0.40	0.07	-5.47	0.00	0.29	0.56
Richest	0.27	0.05	-6.81	0.00	0.18	0.39
Baseline: poorest	1.00					
Number of household members						
6-10	0.96	0.10	-0.45	0.66	0.78	1.17
more than 10	1.48	0.26	2.26	0.02	1.05	2.08
Baseline: 1-5	1.00					
Mother's social characteristics						
Years of education	0.95	0.01	-3.58	0.00	0.92	0.98
Mother works	0.90	0.09	-1.04	0.30	0.73	1.10
Baseline: mother doesn't work	1.00					
Regular exposure to media	1.00	0.11	-0.00	1.00	0.80	1.25
Baseline: no regular media exposure	1.00					
Child's characteristics						
Child is a girl	0.83	0.08	-2.00	0.05	0.68	1.00
Baseline: child is a boy	1.00					
Low birth weight	3.34	0.40	10.06	0.00	2.64	4.23
Baseline: Normal birth weight	1.00					
Country dummy						
Burundi	0.98	0.17	-0.12	0.90	0.70	1.37
Mozambique	0.40	0.05	-6.89	0.00	0.31	0.52
Nepal	1.13	0.23	0.59	0.56	0.76	1.68
Rwanda	0.29	0.07	-4.97	0.00	0.18	0.48
Constant	0.44	0.08	-4.80	0.00	0.32	0.62
Community-level variance	0.19	0.08			0.08	0.43
Log likelihood	-1,585					
number of observations	4,841					

Table M.2 Complete regression results for less rapidly urbanising countries

Child underweight	OR	SE	z	P>z	95% CIs	
variable						
Household assets						
Poorer	0.94	0.14	-0.41	0.68	0.70	1.26
Middle	0.86	0.13	-0.95	0.34	0.64	1.17
Richer	0.84	0.14	-1.06	0.29	0.62	1.16
Richest	0.55	0.10	-3.24	0.00	0.39	0.79
Baseline: poorest	1.00					
Number of household members						
6-10	0.96	0.10	-0.35	0.73	0.78	1.19
more than 10	1.22	0.17	1.45	0.15	0.93	1.60
Baseline: 1-5	1.00					
Mother's social characteristics						
Years of education	0.91	0.01	-6.43	0.00	0.89	0.94
Mother works	0.95	0.09	-0.50	0.62	0.80	1.15
Baseline: mother doesn't work	1.00					
Regular exposure to media	0.90	0.10	-0.94	0.35	0.72	1.12
Baseline: no regular media exposure	1.00					
Child's characteristics						
Child is a girl	0.85	0.08	-1.84	0.07	0.71	1.01
Baseline: child is a boy	1.00					
Low birth weight	2.66	0.35	7.38	0.00	2.05	3.45
Baseline: Normal birth weight	1.00					
Country dummy						
DRC	1.43	0.19	2.65	0.01	1.10	1.86
Senegal	0.58	0.10	-3.11	0.00	0.41	0.82
Sierra Leone	0.98	0.19	-0.10	0.92	0.66	1.45
Niger	1.22	0.19	1.24	0.21	0.89	1.67
Constant	0.33	0.06	-5.83	0.00	0.23	0.48
Community-level variance	0.13	0.06			0.05	0.33
Log likelihood	-1,670					
number of observations	4,214					

APPENDIX N SENSITIVITY ANALYSIS FOR MODELS IN CHAPTER 5

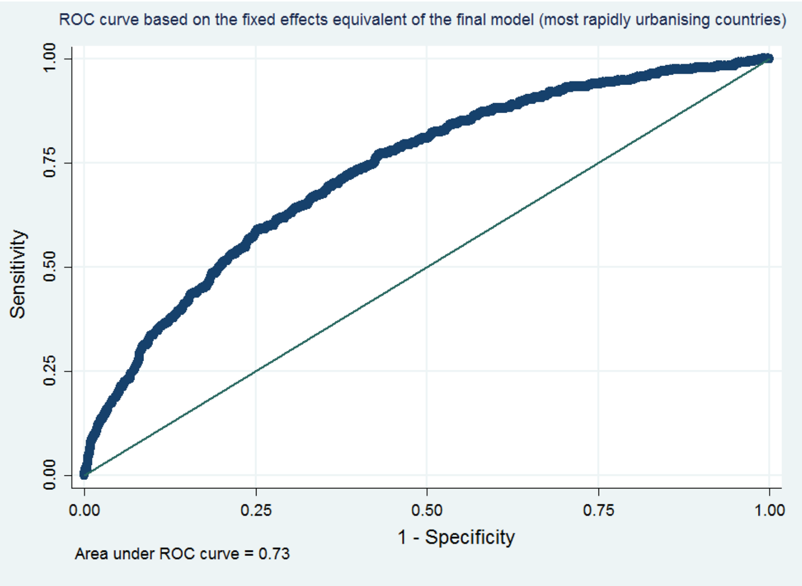

Figure N.1 ROC curve for most rapidly urbanising countries (outcome variable: underweight).

Note: According to the results of the classification table 88.14% of the cases were correctly predicted. Sensitivity analysis is based on the equivalent fixed effect model as this option is not available for multilevel models.

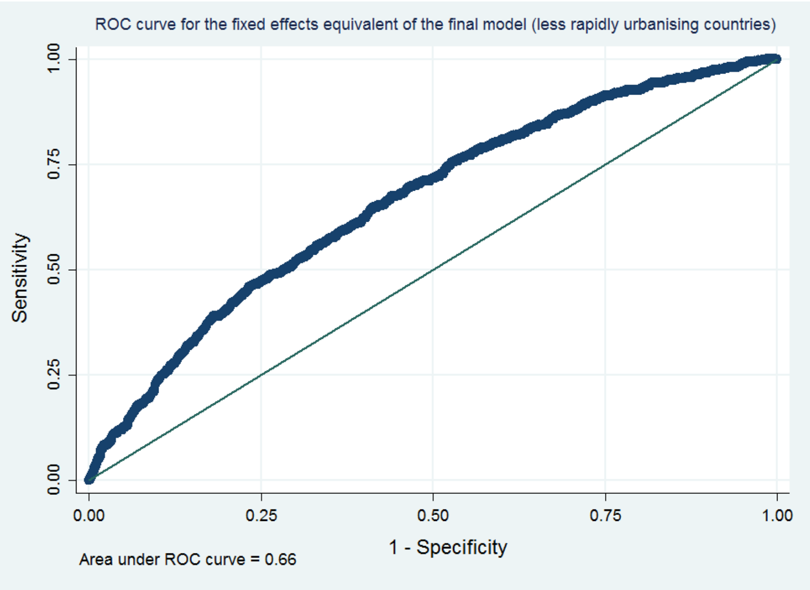

Figure N.2 ROC curve for less rapidly urbanising countries (outcome variable: underweight).

Note: According to the results of the classification table 85.22% of the cases were correctly predicted. Sensitivity analysis is based on the equivalent fixed effect model as this option is not available for multilevel models.

APPENDIX O ADDITIONAL REGRESSION MODELS FOR CHAPTER 5 - OUTCOME VARIABLE: STUNTING

Table O.1 Regression results for child stunting (most rapidly urbanising and less rapidly urbanising LDCs).

Child underweight	**Most rapidly urbanising LDCs**	**Less rapidly urbanising LDCs**
Variable	OR (CI)	OR (CI)
Household assets		
Poorer	0.86 (0.69; 1.06)	0.96 (0.76; 1.21)
Middle	0.62 (0.44; 0.77)***	0.77 (0.61; 0.98)**
Richer	0.45 (0.36; 0.57)***	0.53 (0.41; 0.69)***
Richest	0.33 (0.25; 0.43)***	0.41 (0.31; 0.54)***
Baseline: poorest	1.00	1.00
Number of household members		
6-10	1.03 (0.89; 1.19)	0.89 (0.76; 1.05)
more than 10	1.24 (0.95; 1.62)	1.14 (0.91; 1.41)
Baseline: 1-5	1.00	1.00
Mother's socio-educational characteristics		
Years of education	0.93 (0.91; 0.95)***	0.94 (0.92; 0.97)***
Mother works	0.88 (0.76; 1.03)	0.95 (0.82; 1.09)
Baseline: mother doesn't work	1.00	1.00
Regular exposure to media	1.03 (0.88; 1.22)	0.86 (0.72; 1.03)
Baseline: no regular exposure to media	1.00	1.00
Child's characteristics		
Child is a girl	0.75 (0.65; 86)***	0.74 (0.64; 0.85)***
Baseline: child is a boy	1.00	1.00
Low birth weight	2.13 (1.74; 2.60)***	2.23 (1.77; 2.82)***
Baseline: Normal birth weight	1.00	1.00
Country dummy		
Burundi	2.64 (2.01; 3.48)***	
Mozambique	1.86 (1.52; 2.27)***	
Nepal	1.44 (1.01; 2.05)**	
Rwanda	1.31 (0.97; 1.78)*	
DRC		0.90 (0.74; 1.09)
Senegal		0.29 (0.22; 0.38)***
Sierra Leone		0.38 (0.28; 0.53)***
Niger		0.40 (0.31; 0.52)***
Constant	0.60 (0.46; 0.78)***	0.33 (0.3; 0.48)***
Community-level variance	0.16 (0.09; 0.29)**	1.69 (1.26; 2.27)**
Log likelihood	-2,628	-2,396
number of observations	4,837	4,208

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