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The Future Fertility of High Fertility Countries: A Model Incorporating Expert Arguments

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Contents

Abstract

This paper presents and justifies a set of assumptions regarding the future of fertility in high-fertility countries based on an overview of fertility experiences in these countries, a review of factors influencing fertility change, a global survey of experts, and a final experts' meeting. Future fertility trends in high fertility countries, particularly in sub-Saharan Africa and South Asia will be the main determinants of global population growth over the rest of this century. Accordingly, this paper describes the diversity of experiences of the countries with currently high fertility, from those well advanced in the fertility transition to countries that have barely started. The expert survey emphasizes the importance of female education, urbanization and access to family planning in fertility declines. The literature review confirms these judgments. The paper ends with a technical description of the procedure for deriving the assumptions for projecting fertility in high fertility countries until 2100.

The contributing authors were selected as lead experts in respective topics and regions. Specifically, they have provided texts to the following sections: Donatien Beguy of Section 2.1.3 ("Uganda"); John Casterline of Box 2 ("A focus on the unmet need for family planning"); Teresa Castro-Martin of Section 2.4.1 ("Guatemala"); Youssef Courbage of Section 2.3.2 ("Yemen") and 2.3.3 ("Morocco"); Gavin Jones of Section 2.2.3 ("Indonesia"); Samir K.C. of Section 3.7 ("The impact of education in the course of demographic transition – Empirical Evidence"); James K.S. of Section 2.2.1 ("India"); John F. May of Section 2.1 ("Sub-Saharan Africa") and 2.1.1 ("Niger"), and Box 3 ("A focus on population policies"); Blessing Mberu to Section 2.1.3 ("Uganda"); Michaela Potančoková of Section 3.7 ("The impact of education in the course of demographic transition – Empirical Evidence"); Zeba Sathar of Section 2.2.2 ("Pakistan"); Bruno Schoumaker to Box 1 ("A focus on stalling fertility"); David Shapiro to Section 2.1.2 ("D. R. Congo"); Laura Wong of Section 2.4.3 ("Bolivia"); Brenda Yepez-Martinez to Section 2.4.2 ("Venezuela").

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The Future Fertility of High Fertility Countries: A Model Incorporating Expert Arguments

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1 Introduction: Summary of Past Trends

Beginning in 1960, a phenomenon occurred that John Caldwell named the "global fertility transition"(Caldwell 1997), in which fertility declines have become the general rule throughout the world, including in the majority of the less developed countries. This is important partly because fertility is in many circumstances negatively associated with socioeconomic development (Bryant 2007). From 1970-1975 to 2005-2010, the average total fertility rate (TFR) for the developing world fell by half, from 5.4 to 2.7 births per woman on average (United Nations 2011). However, global figures hide important differences in fertility levels among the different regions. In Asia and Latin America, the reproductive behaviour of women reflected the pattern of change noted by Caldwell, halving the TFR in the past 35 years. In Africa, on the contrary, fertility stagnated at 6.2-6.4 from 1950 to 1985, and then began a decline that was much slower than in other developing regions (see Figure 1). As a whole, the TFR of sub-Saharan Africa has been for decades higher than the fertility levels elsewhere. This was the case in 1950 and 1975, and remains so today.

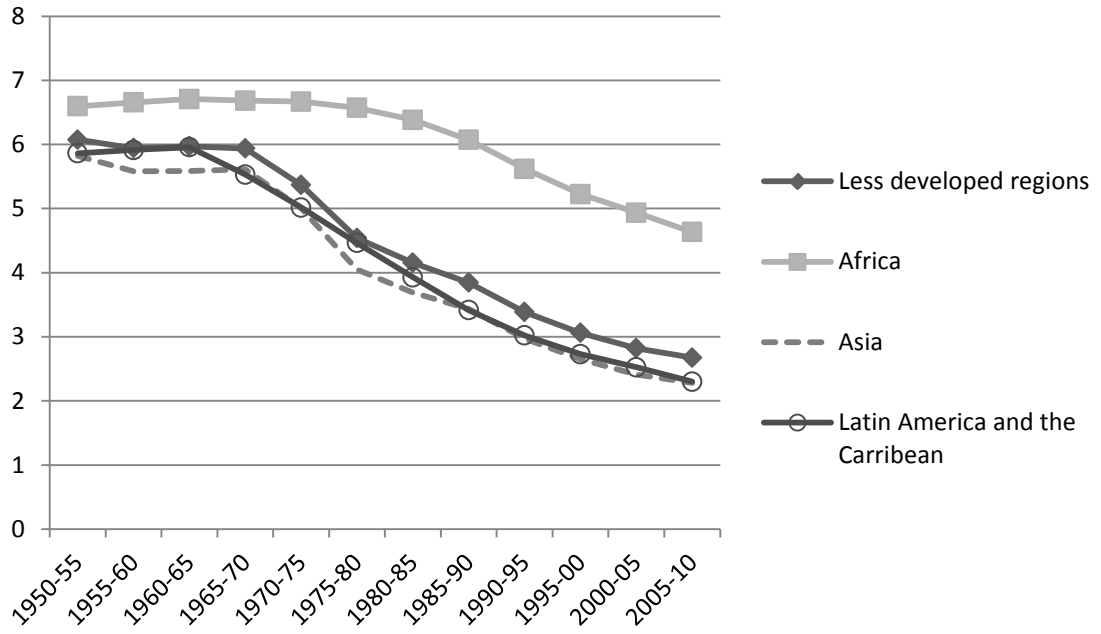

Figure 1. Total fertility rates among major regions of the world and for the less developed countries over time - Source: (United Nations 2011).

Fertility differences among countries are now larger than ever because transitions to replacement fertility have not yet started in some subpopulations of Western and Middle Africa, but have already been completed in others (e.g., in the economically most advanced countries of Asia, especially East Asia, as well as in many countries in Latin America and the Caribbean). As a result, the observed TFRs of (former) developing countries in 2005-2010 range from a high of 7.1 in Niger[1] to a low of 1.0 in Hong Kong[2].

All regions of the world experience wide variations in their TFRs. For instance, East Asia has experienced a faster fertility decline than countries like Pakistan in South Central Asia. Moreover, fertility levels can show significant variations within a single country. This is the case in India, where Northern and Southern patterns of fertility are very different. Overall, regional variations are most apparent in sub-Saharan Africa. Southern Africa, which represents only seven percent of the sub-Saharan Africa population, has a TFR of 2.5, whereas Eastern Africa has a TFR of 5.1, and Western Africa and Middle Africa have TFRs of 5.4 and 5.9, respectively.

The future world population will depend substantially on the speed of the fertility decline in the sub-regions that still follow high patterns of fertility. The topic generates conflicting views. Although the mechanisms behind the fertility decline are well known – particularly in terms of education, family planning, women empowerment, and urbanization – their spread and future intensity are not certain and the relationships between the causal factors and the fertility reductions are not linear.

The first part of this article analyses the trends in the fertility decline in the remaining world regions with high fertility, and focuses on the historical and present fertility trends in a few countries in each region. The second part presents the theoretical framework explaining the fertility path, which is dominated by demographic transition theory. This theory assesses fertility decline as part of development as societies transition from traditional to modern ones. We also examine fertility stalls, which are counter-examples to that theory. The third and fourth parts adopt a forward-looking perspective that provides insights into future fertility trends. In the third part, we present and analyse results of the survey and meta-expert meeting that provided input into the projection process carried out by the Wittgenstein Centre for Demography and Global Human Capital (WiC) and reported in *World Population and Human Capital in the 21st Century* (Lutz et al. 2013). In the fourth part, we explain how we translated the analysis of past and present trends and the expert views on the future into fertility assumptions for the projections. We conclude the article with a section on the future fertility differentials by education. Education is a common thread in all sections of this paper as it is an important indicator of "development" having a strong influence on women's fertility.

[1] The latest survey carried out in 2012 even points at a fertility increase to 7.6 children – see Section 2.1.1.

[2] According to the classification of countries by the United Nations. see http://esa.un.org/unpd/wpp/Excel-Data/definition-of-regions.htm [16/04/2013].

2 Different World Experiences

The transition to lower fertility has occurred at different speeds, and some countries and regions are still in its midst. Below we review the main trends at the regional level in sub-Saharan Africa, the Middle East, North Africa (MENA), Asia, and Latin America. We also present case studies of three countries within each region that either exemplify or diverge from the general picture.

2.1 Sub-Saharan Africa

With the exception of Southern Africa, sub-Saharan Africa is experiencing the demographic transition much later than all other world regions. Some rural regions of several sub-Saharan countries have not yet started their fertility transition in earnest, e.g. in the three case studies presented below: the Democratic Republic of Congo (D.R. Congo), Niger, and Uganda. Even in sub-Saharan Africa countries where fertility has declined, the pace of fertility reduction has usually been very slow. The current prospects for rapid fertility decline in this area are therefore less promising than the experience in other regions, and the future trajectory of fertility in sub-Saharan Africa might be much slower than anticipated in the current UN population projections (United Nations 2011), where the TFR is declining from 4.8 (in 2010-15) to 2.1 by the end of the century in the medium variant.

The reasons are manifold, including poor socioeconomic outcomes, the high level of desired fertility (even among the educated population), and the timid policy approaches to the issue of rapid population growth on the part of African leaders and elites. Female literacy rates are still very low in sub-Saharan Africa, and so are income per capita and labour force participation in the formal sector. Organized programs of family planning have generally been weak, as well. The latent demand (unmet need) for contraceptive use is also low (around 25 percent on average), and the pace of increase of contraceptive coverage has been very slow, Rwanda being a noteworthy exception (Westoff 2013). Some countries have even experienced a reversal in overall contraceptive coverage, sometimes accompanied by a decline in the percentage of women in unions[3] using modern contraception since 2000. This is particularly true in Guinea, D.R. Congo, and Chad[4]. Because the future of population growth in sub-Saharan Africa hinges on fertility, the key research question is how soon fertility could decline, especially in the three sub-Saharan Africa sub-regions (Western, Eastern, and Middle Africa) where the TFR is still above 5 children per woman. Traditional social norms favouring high fertility and poor access to family planning services may prevent fertility from declining rapidly.

2.1.1 Niger

Between 1950 and 2010, the population of Niger in Western Africa grew from 2.4 million to 15.5 million—a six-fold increase (United Nations 2011). The mortality

[3] In most countries where fertility is high, childbearing primarily occurs inside marriage. Hence interviews in surveys on fertility are often conducted only with married women.

[4] As can be seen from the database on contraceptive prevalence rate (Millennium Development Goals): www.un.org/en/development/desa/population/theme/mdg/index.shtml [18/4/2013]

decline that had induced this growth could accelerate in the future, fuelling further population growth, unless episodes of famine become more frequent. International migration could reduce population growth somewhat, with an estimated 166 thousand Nigeriens leaving the country every year (République du Niger 2012), although it seems that many Nigeriens have recently returned from foreign countries (e.g., from Libya). Niger has one of the highest fertility rates in the world and fertility has declined only very slowly in the past, with the most recent round of Demographic and Health Survey (DHS) even showing an increase in the total fertility rate from 7.1 in 2006 to 7.6 in 2012(DHS Niger 2012; DHS Niger 2006). Desired fertility remains very high, including among women with five children, of whom only nine percent do not desire an additional birth. This is the case even among the more educated: people with secondary schooling still want six children, according to the 2006 DHS (DHS Niger 2012; DHS Niger 2006). Although the use of any contraceptive method has increased slightly from 11 to 14 percent in the last 6 years (DHS Niger 2012), the demand for contraceptives and the resulting unmet need for family planning remain modest. Women, especially in rural areas, have little information on family planning methods and, as a result, have difficulty making an informed choice concerning family planning methods.

The UN estimates that the total fertility rate in Niger will decrease to 4.2 children per woman by 2050 (United Nations 2011). However, some experts (Guengant & May 2011) doubt that this will happen if age at marriage remains very low, if social norms do not change, and if the contraceptive prevalence rate does not increase more rapidly. The future of fertility decline in Niger will depend on these factors, along with the age at first birth, success in empowering women, efforts to promote female education, and political commitment to set up organized family planning programs. Among these factors, addressing the prevalence of "child marriage" might not be feasible, as public authorities may not be able to muster the political will to combat traditions that have long been culturally entrenched.

2.1.2 D. R. Congo

The D.R. Congo is a high-fertility country in Middle Africa with little evidence of fertility decline at the national level (Romaniuk 2011). Its population has increased from 12 million in 1950 to 66 million in 2010 (United Nations 2011). At the same time the DRC’s capital, Kinshasa, the second-largest city in sub-Saharan Africa with about nine million inhabitants, has seen its fertility decline by half between 1975 and 2007 (Shapiro 2012).

The history of fertility is shown on Figure 2. Data from a large national survey carried out in the 1950s indicate that the TFR at the national level was 5.9, while the TFR for Kinshasa was estimated at 7.5 (Romaniuk 1967; Romaniuk 1968). The higher fertility of the city reflects in large part the incidence of venereal disease in the countryside, resulting in high levels of sterility in the North, which was part of a Central African infertility belt (Retel-Laurentin 1974; Romaniuk 1961).

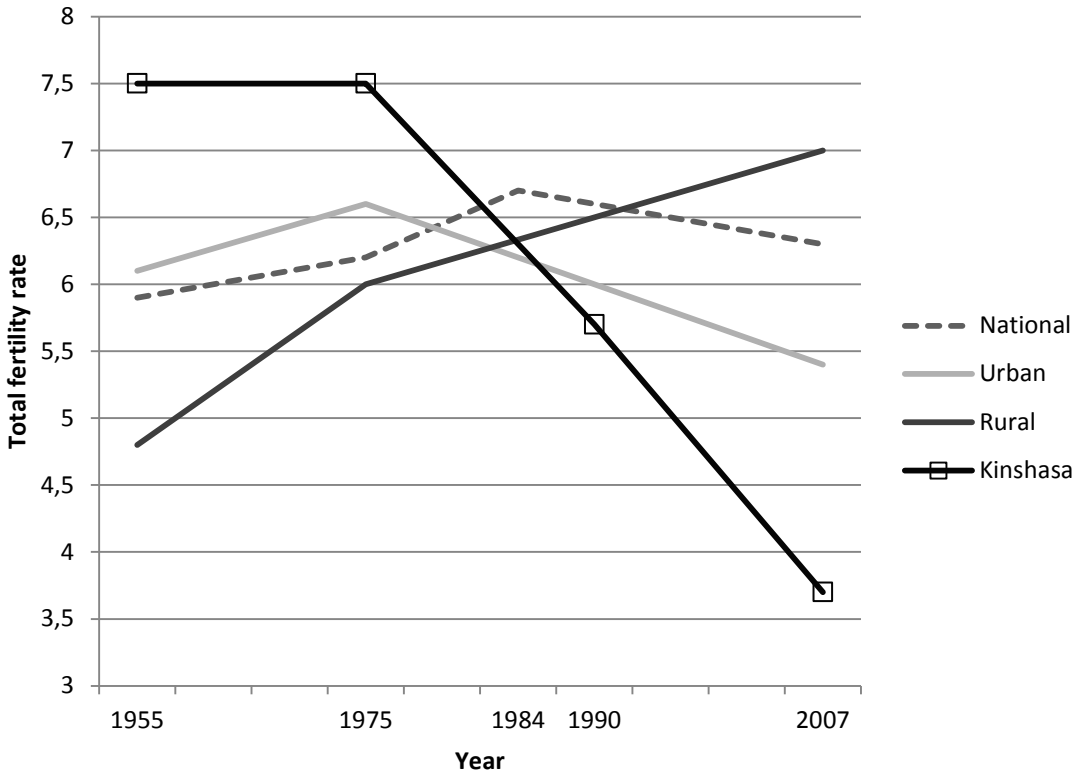

Figure 2. Total fertility rate by place of residence, D.R. Congo (different sources)

Following independence in 1960, a major demographic survey was carried out the mid-1970s in the western part of the country, a national census was done in 1984, a DHS was completed in 2007, and three national Multiple Indicator Cluster Surveys (MICS) were conducted in 1995, 2001, and 2010. These many surveys suggest first that for at least the two decades following independence, fertility in the DRC rose somewhat due in part to public health campaigns that reduced the incidence of sterility in the North. Another factor in the increase was the initiation of some modernizing behaviours in the population, reducing the impact of traditional restraints such as post-partum sexual abstinence and prolonged breastfeeding, thereby contributing to higher fertility (Romaniuk 1980). In 2007, the overall TFR in the DRC was estimated to be 6.3. The rural TFR was 7.0, compared to an urban TFR of 5.4 (Ministère du Plan and Macro International 2008). The TFR for Kinshasa was 3.7; the TFR for other urban areas was 6.3. The 2010 MICS showed mostly similar numbers: an overall TFR of 6.3, with 7.1 at the rural level, 4.8 at the urban level, and 3.5 for Kinshasa (Institut National de la Statistique et Fonds des Nations Unis pour l'Enfance 2011). While allowances should be made for sampling variability across data sets, these numbers suggest that a fertility decline is on-going in Kinshasa, at best only beginning in other urban settings, and not yet evident in rural areas or for the country as a whole.

In considering determinants and correlates of fertility as part of the process of understanding the fertility transition, Romaniuk (2011) emphasizes the desirability of a balanced approach that takes into account both the forces of tradition that typically hinder fertility decline and the forces of modernization that tend to foster fertility

transition. For the DRC overall, the forces of tradition are clearly stronger at present than the forces of modernization. Even for Kinshasa where a fertility decline has taken place, it appears that the decline is less a consequence of the strong forces of modernization than a reaction to the extended persistence of economic hardship (Shapiro 2012). Hence, at least in the near-term, future fertility in the DRC will likely remain high.

2.1.3 Uganda

Uganda has among the highest total fertility rates in sub-Saharan Africa. Accordingly, the country's population has grown rapidly in recent decades, increasing from 9.5 million in 1969 to 24.2 million in 2002, and reaching 32.9 million in mid-2011 (Uganda Bureau of Statistics 2012). Still, data from four rounds of nationally representative Uganda DHSs show a marginal decrease (nine percent) in the country's fertility rates, declining from 7.4 children per woman in 1988 to 6.7 in 2006/2007 (DHS Uganda 2012).

As a result of lower mortality but still high fertility, Uganda has developed one of the world's youngest age structures, with half of its population aged 15 or younger (Haub & Gribble 2011). The country's population will continue to grow, as large numbers of people are either currently of child-bearing age or will soon enter that age group. If current fertility levels persist, the country's population is projected to reach 70 million by 2031 and could attain 100 million after 2040, a near tripling of its current size (Haub & Gribble 2011).

While fertility has remained at pre-transition levels over the past 20 years, there are signs of decline within particular sub-groups of women, namely the most educated and those living in urban areas and in the Central region. Conversely, fertility hovers around seven children per woman in some areas, particularly the Eastern region where TFR increased from 7.4 in 2000 to 7.6 by 2006/2007. Consequently, there are calls for specific actions to reverse increasing levels of desired family size and growing negative attitudes toward family planning. There are also calls to address high levels of unmet need for family planning (40 percent in 2011) and high levels of unintended pregnancies (46 percent in 2011).

2.2 Asia

Asia has been characterised by large fertility declines over the second half of the last century, starting with Eastern Asia. Japan's early transition began in the 1930s, followed by Hong Kong, Taiwan, and Singapore in the 1960s. Rapid industrialisation, economic wealth, the spread of education, particularly among women, and the diffusion of contraceptive use in the context of strong political commitments have played a significant role in bringing about a rapid pace of fertility decline in most Southeast Asian countries, one of the most rapid in the developing world. Indonesia (see case study) belongs to those countries that began their fertility transition at higher levels of socioeconomic development and have progressed much faster in approaching replacement-level fertility. These countries were able to reap the demographic dividend which was arising from having the largest share of the population of working age, faster than other countries, mostly in South Asia, that are at different stages of this transition. In India (see case study), although fertility has been rapidly declining, some states have

seen less substantial fertility declines than others. However, ideational change and the wish for smaller families are underway in all states, and family planning diffusion will certainly facilitate further declines. The picture is slightly different in Pakistan (see case study below) where increasing female education and meeting the unmet demand for family planning will be key challenges.

2.2.1 India

India experienced a modest decline in fertility during the second half of the 20th century. The pace of decline has, however, quickened over the last two decades. According to the Sample Registration System (SRS) data available since 1970, TFR has declined at 1.5 percent per annum until around the early 1990s. While TFR was around 5.2 in the early 1970s, it reached a level of 2.5 by 2010. Given this pace of decline, India is expected to reach replacement fertility levels toward the second half of this decade (Office of the Registrar General of India 2006).

Interestingly, the fertility transition has been quite uneven across the regions and states in the country. Among the 20 largest states, 11 (home to nearly 48 percent of India's 1 billion population) have already achieved replacement fertility (James 2011). In eight states, the TFR is hovering around 1.8 children. In contrast, in the nine states constituting more than 50 percent of India's population, fertility levels are above replacement. Still, the pace of fertility decline has quickened everywhere in the last few years. Even the state with the highest fertility, Bihar, has recorded a strong decline, from 4.3 in 2005 to 3.7 in 2010 (Office of the Registrar General of India 2012).

The desired number of children has also come down significantly over the recent period, reaching replacement level according to the 2005-2006 DHS. The total "wanted" fertility rate (calculated as the difference between desired number of children and actual number born) was only 1.9, lower by 0.8 child than the total fertility rate of 2.7, based on the most recent DHS. The decline in the desired number of children among illiterate women, from 3.2 in 1992–1993, to 2.2 in 2005–2006, is an example of such a change.

At the same time, marriage remains nearly universal in India. The weakening of the institution of marriage, which is one of the major routes of sustaining below-replacement fertility, has not affected India to any significant extent. The mean age at marriage has risen slowly. Therefore, it is still unclear how low the Indian TFR will go, given the country's socio-cultural context.

India's fertility transition has been unique in many respects. Most notably, the transition has occurred without notable improvements in socioeconomic conditions Indeed, the Indian fertility decline has been mainly among illiterate women (Mari Bhat 2002). With the female literacy rate remaining low, the only way to achieve drastic fertility reduction has been diffusion among illiterate women of the idea of having only a few children. The experience of the recent decades gives credence to the fact that the country has been successful in spreading this small-family message (Dreze & Murthi 2001; Guilmoto & Rajan 2001). At the same time, the educational gradient of fertility still remains significant. Illiterate women bear on average around 3.4 children as against 1.8 for those having graduate and higher educational levels.

On the whole, it appears that India is on a course of rapid fertility changes and approaching replacement-level fertility. With the narrowing of fertility differences

across states and across educational categories, fertility is even likely to fall below replacement level. However, it is still not clear whether the country will achieve the very low fertility of many European countries, given India's rigid religious and cultural context.

2.2.2 Pakistan

Pakistan, a country that has seen its population more than double from 60 to 174 million between 1980 and 2010 (UN, 2011a), stands apart from other populous countries in South Asia that have already experienced substantial declines in fertility. In the 1980s and 1990s there was a wide divergence of opinion about levels of fertility, mainly reflecting the findings of various surveys that followed different approaches. There is consensus, however, on the beginning of fertility decline in Pakistan (Feeney & Alam 2003; Sathar & Casterline 1998), based on 1990s data that show a distinct decline.

Considered together, estimates imply a considerable decline of around 1.5 births per woman from the late 1980s through the 1990s (Sathar & Zaidi 2011). The decline in fertility from the PDHS 1990-1991 was from 5.8 births to 4.8 births in 2000, according to the Pakistan Reproductive Health and Family Planning Survey. The annual Pakistan Demographic surveys showed a sharper decline (starting higher) from 6.2 births per woman in 1990 to 4.5 births per woman by 2000 (Feeney & Alam 2003).

Demographers were optimistic about the speed of further fertility decline in Pakistan after 2000; however the decline did not continue at the same pace. The Pakistan Demographic Surveys (PDHS 2008) show a decline from 4.1 to 3.7 births in the period 2001-2007, while the fertility surveys show TFR declining from 4.8 (Hakim et al. 2001) to 4.1 births per woman for the period. While there is still a divergence in rates between the two types of surveys, it is much narrower than in earlier years. The preliminary report of the most recent PDHS (2013) estimates a TFR of 3.9.

The speed and timing of the decline are very different for urban and rural areas. Urban areas experienced the fertility transition earlier and much more rapidly. The TFR in urban areas declined by almost two births, from 5.6 births per woman in the 1980's to 4.9 in 1990, and 3.8 births per woman by 2000. But in the last decade the urban fertility decline has slowed, with TFR at only 3.3 by 2007. On the other hand, rural fertility remained above 6 births per woman until the mid-1990s at which time it declined from 6.3 births per woman (Ministry of Population Welfare 1995) to 5.4 births per woman by 2000 (Hakim et al. 2001), and to 4.5 births per woman by 2006-7. Consequently, there has been some narrowing of the rural-urban differential from the initial 1.7 births in 2000 to 1.2 births by 2007.

Prospects for future fertility decline have kept changing in Pakistan. Demographers were first encouraged by the rapid fertility decline of the 1990s and then cautioned by the unexpected slowing in the last decade. Pakistan lacks national fertility estimates after 2007. The various scenarios of fertility decline depend on the priority that the Government of Pakistan, other policymakers in the development sector, and donors assign to the expansion and improvement of family planning services. With improvements in such services, there is huge potential for meeting unmet demand for family planning in the country and thus for fertility to decline at a more rapid pace. Otherwise, fertility will decline slowly and possibly erratically over the next two decades.

2.2.3 Indonesia

Indonesia experienced a relatively rapid decline in its TFR, from about 5.4 in 1970, with a population of 118 million, to about 2.4 in 2010 – when the population doubled from its 1970 level of 240 million (United Nations 2011). While far less spectacular than those of Singapore and Thailand, this decline was almost as rapid as in the Latin American countries with the most rapid fertility declines (Mexico, Brazil, and Costa Rica), and was notable for having occurred in a country with a low level of per capita income and a relatively high proportion of the population living in rural areas. The decline was characterized by less urban-rural difference than was the case for many other countries and less difference by educational background, but substantial regional differences.

What were the underlying causes of this decline? Comparing the situation in 2010 with that in 1970, notable changes had occurred in every aspect of economic and social conditions. Relatively high rates of economic growth had been achieved, punctuated by short periods of economic crisis, the most severe of which was the Asian financial crisis of 1997-1998. By 2010, almost 50 percent of the population was living in urban areas, per capita income in purchasing power parity terms was much higher than in 1970, and the infant mortality rate had fallen from slightly over 100 per 1000 live births in 1970 to about 27 in 2010. The gross secondary school enrolment ratio had risen from about 15 in 1970 to about 79 over the same period. Between 1970 and the late 1990s, an effective family planning program was mounted by the government, which to some extent lost its way after the economic crisis and the new regional autonomy programs adopted after 2001. These undercut the centralized direction and management of the program, which had been an important element in its success.

Generally accepted explanations for the Indonesian fertility decline are based on rapid socioeconomic development and on the role of the family planning program. However, these could be called into question by comparing the decline with that of Myanmar, where the trend in TFR was remarkably similar to that in Indonesia despite Myanmar's poor record of economic and social development over the same period. Myanmar also lacked a family planning program, with government officials showing some hostility toward family planning during the earlier part of the period. However, the onus of providing a persuasive explanation of the fertility decline seems to rest more on the case of Myanmar than on that of Indonesia.

Indonesia has the largest Muslim-majority population in the world, with Muslims making up 87 percent of its 240 million population. Although the sharp decline in fertility in a number of Muslim-majority countries has undercut the long-standing belief that Muslim populations are inherently resistant to fertility decline, a potential resistance to family planning by local level Islamic leaders was certainly anticipated and effectively neutralized by the Indonesian family planning program operating in the context of strong control over Islamic political forces during the Suharto era. This stands in sharp contrast to the failure to neutralize Islamic opposition to family planning in countries such as Pakistan.

More recently, however, the Indonesian fertility decline has slowed, albeit at a level of TFR that is not much above replacement level. Over the decade 2000-2010, the TFR has fallen only slightly, although sources differ on the extent of the decline and the exact numbers involved. The DHS and contraceptive prevalence surveys yield higher

TFR estimates than do the Census and other major socioeconomic surveys. Hull and Hartanto (2009) demonstrate effectively that the DHS 2007 under-sampled single women living outside their parents' household. Accordingly, they suggest an adjustment of the DHS TFR for 2005-2007 from 2.6 to 2.3. While the deceleration in fertility decline is often attributed to the problems facing the family planning program, it seems to be related more to an upturn in Islamic religiosity and a related emphasis on marriage and family building (Sakai & Fauzia 2013). Over the period from 2006 to 2010, the mean age at marriage has fallen, the first such decline recorded in recent decades anywhere in Southeast Asia. The future trajectory of such a trend in religiosity is hard to predict but needs to be kept in mind as an influence on future trends in Indonesian fertility. Concerns that a major upsurge in fertility will take place appear to be unfounded, however, given the continuing rapid pace of socioeconomic development and the lack of evidence of fertility upturns in other Muslim-majority countries.

2.3 Middle East and North Africa (MENA)

The fertility transition is well underway in most countries of the MENA region, although in the 1980s it was considered to be one of the main counter-examples to demographic transition theory, as the region was experiencing strong improvements in health and general development without showing significant signs of fertility decline. In 2010, a number of countries approached replacement fertility, particularly in North Africa (Morocco, Algeria, and Libya), or had already reached below replacement levels. These countries included Tunisia, Lebanon, Bahrain, Kuwait, and the United Arab Emirates. Morocco (see case study below), which is one of the least developed countries in the Arab world, anticipated the movement of fertility decline ahead of many other MENA countries. In the other Eastern Mediterranean countries such as Egypt, Jordan, and Syria, fertility is also declining significantly. Only the Palestinian Territories and Iraq still exhibited a TFR above 3.5 children in the 2005-2010 period (United Nations 2011).

If decreased nuptiality and marriage postponement were the main factors in the fertility decline so far, progress in contraceptive prevalence rates and educational levels among the young female population are pointing to further declines. However, as the Egypt case study shows, the norm in terms of number of children desired by couples might be an obstacle to more rapid fertility declines. In the less developed Arab countries, such as Mauritania, Sudan and Yemen, the fertility transition started less than 20 years ago and fertility levels remain high (see the case study of Yemen below), with an uncertain future.

2.3.1 Egypt

In comparison to other Arab countries, the decline in fertility in Egypt was quite slow, comparable to that in Sudan, Bahrain, and Yemen, among others (United Nations Economic and Social Commission for Western Asia 2005), leading to substantial increase in the population from 40 to 81 million between 1975 and 2010 (United Nations 2011). There were two main phases in the Egyptian fertility decline. It was quite rapid between 1980 and the mid-1990s, when the total fertility rate declined from 5.3 children per woman (1979-1980) to 3.3 (1995-1997). Between 1995 and 2005, the fertility decline slowed, and two DHSs even indicated an increase in TFRs around 1998

and 2000 (Eltigani 2003; El-Zanaty & Way 2004). However, Engelhardt (2005) hypothesized that the indicated increase could have been spurious. According to Eltigani (2003), households with higher education and income were responsible for the stalling of fertility at a time when women in other education categories also experienced a levelling off of their fertility. The fertility of women with a secondary education and higher has been constant during the last 15 years, at about 3.0 children per woman between 1992 and 2005. A survey conducted by the Cairo Demographic Center (2006) showed that the gender bias toward boys and the desire to have three children, in addition to peer pressure, are the main reasons for having more than two children among the more highly educated. In the same way, Casterline and Roushdy (2007), while studying fertility desires in an analysis of differences between current fertility levels and replacement-level fertility, revealed the absence of a vanguard group of young, educated and/or wealthy persons who would have adopted the two-child norm in Egypt. Replacement fertility is not yet a desirable goal for a substantial majority of the Egyptian population. The last DHS surveys (DHS Egypt 2009; 2006; 2004) point to the return of a general fertility decline, homogenously across regions although at a very slow pace. The TFR in 2008 was estimated at 3.0 children per woman in the whole of Egypt, down from 3.1 in 2005.

The future of fertility rates in Egypt is highly uncertain. There are several obstacles on the pathway to replacement-level fertility in the near future, some having to do with the difficulty of limiting unwanted fertility, estimated at 1.0 child in 2005. It has been observed that women do not feel committed to their goal of wanted fertility of 2 children (Casterline & El-Zeini 2005). Other obstacles have to do with desired family size, which remains between two and three with no visible changes between the older and younger generations of fertility women. The Arab Spring and the resulting political and economic crisis are other sources of uncertainty regarding the future of fertility in Egypt.

2.3.2 Yemen

There are two ways to look at fertility in Yemen. The pessimistic evaluation sees Yemen as one of the most fertile countries in the world with about five children[5] per woman in 2010, and a doubling of its population in the 20 years since 1990 to 24 million. The more optimistic view emphasizes the achievement of reducing the fertility rate by almost half in the last 30 years, a task that is even more impressive because it was done in the context of a remote and mountainous country with some 70 percent of the population living in rural areas (Courbage & Todd 2011). In spite of a long history of out-migrations that sent Yemenis to Indonesia, the US, and the coasts of Eastern Africa, most migrants went to neighbouring countries like Saudi Arabia, where they were exposed to more conservative values than Arab Maghreb migrants experienced in the European world.

The Yemeni fertility transition started in the middle 1990s, later than most other Arab countries, and at a time when female literacy levels were low. Even now, more than half of women aged 15-24 are illiterate, whereas illiteracy has been eradicated in most other Arab countries. Male literacy is much higher, approaching 95 percent.

[5] Estimates for present fertility diverge greatly: The TFR is 5.0 according to estimates by Courbage, 5.2 according to the Population Reference Bureau (2012), 4.9 according to the United Nations for 2010-2015 (2011), and 4.3 according to the US Census Bureau for 2013.

Hence, males may have taken the lead and could have triggered a significant fertility decline. However, it would be reasonable to imagine that female education will instead become the leading cause of fertility decline in Yemen. The illiteracy rate among the youngest females – those who will soon reach marriage and reproduction ages--is decreasing at a rate of 3.7 percent per annum.

As important as education is, it does not tell the whole story. In many Arab countries, Yemen in particular, other determinants of fertility may also be important. First, a competition over population size[6] is taking place between the two giants of the Arabian Peninsula, Yemen and Saudi Arabia. Yemen currently has the larger population, mostly because of its expatriate population. However, Yemen still experiences internal conflicts between the North and the South that might impact fertility behaviour, partly because of tribalism and the different kinds of Islam practiced across the country, such as the Shiite Yemeni community called *zaidi* which is active in North Yemen.

The "Arab spring", which has led to the exile of Yemen's "president for life", might change the course of fertility trends. Women took to the streets of the capital, and their newly gained political presence might well be followed by an improved access to education, hence pushing fertility to lower levels.

2.3.3 Morocco

Morocco, one of the least developed Arab countries, anticipated fertility transition ahead of the twenty or so other countries of the MENA region, excluding two small ones, Lebanon and Tunisia. Despite an official family planning program launched by King Hassan II in 1966, fertility started to increase rather than decrease, from 7.2 children in 1962, to 7.4 in 1973. As in other countries in the region, revenues from mineral wealth redistributed by the state consolidated large family norms. Morocco's entry into the demographic transition was brought by two political and economic events: The Western Sahara crisis pushed military expenditures forward in 1975 and at the same time, phosphate prices fell. As a result, the state lost its main source of family planning funding, and moreover compensated the drop in state revenues by increasing household taxes. This prompted many women to join the labour force and abandon their traditional role at home a decade ahead of the Arab world (Courbage 1999) Consequently, fertility fell to 5.9 in 1977. Between 1960 and 1995, young women joined the labour force, their share nearly quadrupling from a mere 10 to 37 percent over that time period. The resulting new work patterns influenced marriage and reproduction by creating new time constraints and a weakening of family networks. Since then, fertility has continued to decline at unprecedented rates. Each census or survey held since the World Fertility Survey in 1977 has revealed yet another decline: to 4.5 in 1988, 3.0 in 1999, and 2.2 in 2009-2010.

Therefore, economic and labour market factors among other determinants of fertility—decline in infant and childhood mortality, urbanization, increase of the service sector in the economy, and female education—were decisive in triggering Morocco's fertility decline (Courbage & Todd 2011). However, the impacts of these factors should

[6] The battle of numbers could be also fuelled by the fact that Yemen has claims over the Asir, a Yemeni populated region lost during the war of 1934, to the benefit of the Saudis.

not be overestimated. This is particularly true for female education. The Moroccan fertility transition has gone a long way, whereas female illiteracy is still high (39 percent among women aged 15-24 years).

The gap between Morocco's fertility trends and those in the richer and better educated Middle East—Egypt, Syria, Jordan or the Arabian Peninsula—is not explained by referring to demographic transition theory. Population origins, geography, and colonial and postcolonial history have shaped Morocco in a particular way reflected in its demography. Morocco's family patterns have been influenced by the interdependence with colonial powers France and Spain. Even after independence in 1956, Morocco's identity has had a strong European imprint. Even more significant is the impact of the 2.5 million Moroccans Diaspora living in Western Europe. In the 1960s migrants followed the large family size model. One or two generations later, they became agents of the small nuclear family model. There are no convincing reasons to anticipate a fertility stall in the coming decades; fertility will most likely fall to levels comparable to other countries on the Mediterranean coast.

2.4 Latin America

The demographic transition that started in the 1960s in most Latin American countries originated in radical changes in the socioeconomic environment and in people's attitudes towards fertility regulation when contraception availability was increasing (Guzman et al. 1996). As usual, the global trends hide important differences between and within the countries of the region. This is apparent when comparing in Figure 3 the TFR at the beginning of the transition in 1965-1970, when 36 out of 37 countries of the region had a TFR above 3.0 (except Uruguay where women had on average 2.8 children), and in 2005-2010, when only six countries have had fertility above 3.0 children. In two-thirds of the countries, the current fertility rate is below 2.5 (United Nations 2011). The regional average TFR is 2.2 children per women. Most interesting are the countries where the TFR was still above 3 children in 2005-2010.

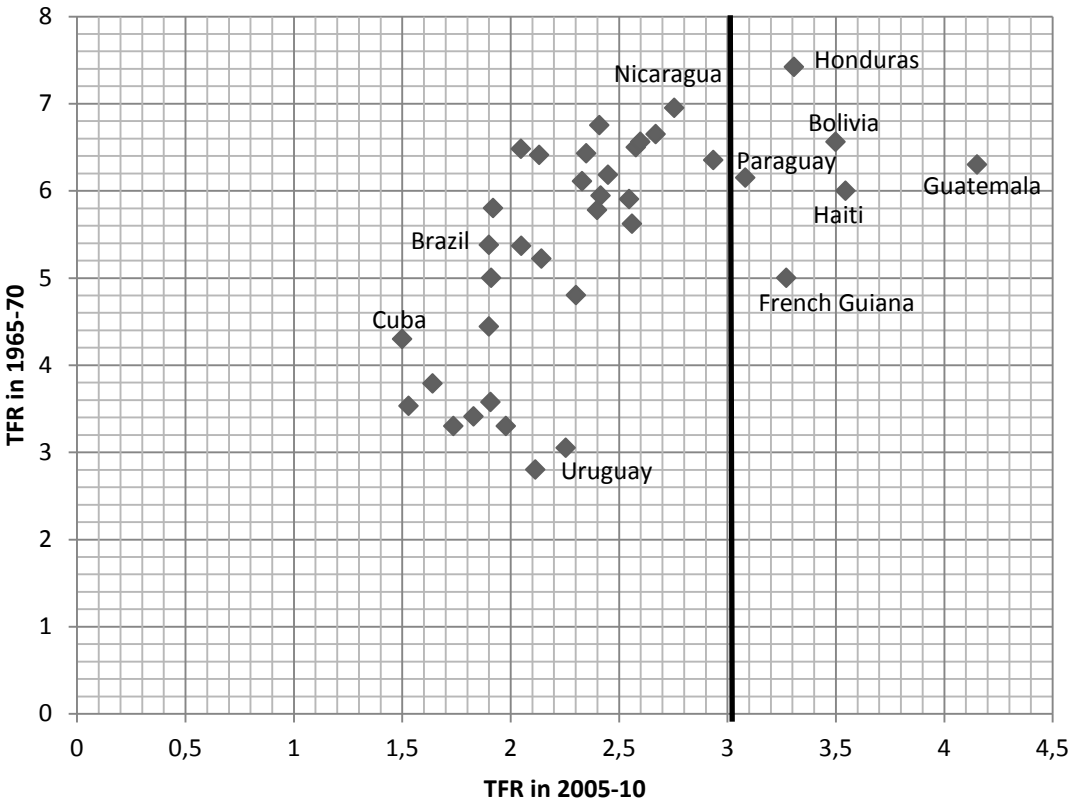

Figure 3. TFR in 1965-70 vs. TFR in 2005-10 (United Nations 2011)

Guatemala presently is among a small group of countries that have the highest fertility rates in Latin America and the Caribbean region. The other such countries are Haiti, Bolivia (see case study below), Honduras, French Guiana, and Paraguay. The lesson from case studies is that countries experience varied reproductive patterns according to socio-demographic factors such as place of residence, education, and ethnicity. For some of these groups particularly, the transition has not yet been completed, even in countries like Venezuela where it is well underway.

2.4.1 Guatemala

According to the most recently available survey data (ENSMI 2008/09), Guatemala's total fertility rate is 3.6 children per woman. Stalled social and economic development is part of the explanation for the relatively slower decline in Guatemala. The country ranks 131 out of 187 countries on the United Nations Development Programme Human Development Index (2011) and maintains the second lowest score – after Haiti – in Latin America and the Caribbean region. Despite being classified as a middle-income country by the World Bank, Guatemala has one of the highest poverty rates and most unequal income distributions in Latin America. The slow pace of fertility decline is not surprising in a country where 51 percent of the population live in rural areas and 20 percent have no access to electricity, 31 percent of adult women and 20 percent of adult men are illiterate, maternal and infant mortality remain high, and nearly half of all children under five suffer from chronic malnutrition (World Bank 2011). Large socioeconomic differentials are reflected in wide fertility gaps, particularly related to

education. The total fertility rate of women with no formal education is 5.2 children, compared to 2.3 children among women with secondary education or more.

Guatemala's fourteen-million population (United Nations 2011) is also varied by ethnicity and language. Indigenous Mayans, who belong to 23 different linguistic groups, make up about half of the population. The vast majority of Mayans live in poverty in rural areas, experience high rates of maternal and infant mortality, and have high illiteracy rates. The violence they suffered during the civil war (1960-1996), which dominated the second half of the 20th century, caused extensive societal disruption and halted the expansion of education and health programs, including those focused on reproductive health. The civil war also sowed distrust towards government-sponsored social programs, including family planning. About forty percent of indigenous women in union use contraception compared to 63.3 percent of non-indigenous women (ENSMI 2008/09). The high proportion of indigenous population combined with marked social, economic, and political inequality has resulted in a two-tier country. Ethnic divides are strongly correlated with geographical location and socioeconomic stratification. The stratification is also manifest in fertility differentials, with the total fertility rate being 4.5 among Mayans, compared to 3.1 among "ladinos", the Spanish-speaking non-indigenous population (ENSMI 2008/09).

The high fertility of Guatemala within the context of Latin America is linked to low contraceptive prevalence rates. Fifty-four percent of women in union use contraception (44 percent modern contraception), whereas the average in Latin America and the Caribbean region is 72.9 percent (67 percent modern contraception). Despite the establishment of a dynamic private family planning association in the mid-1960s, Guatemala still lags far behind its Latin American neighbours in contraceptive use. Governmental opposition to family planning, strengthened by the Catholic Church's conservative stance, also limited the role of international programs and non-governmental aid organizations in the area of family planning. Guatemala was one of the few nations that did not fully endorse the Plan of Action of the 1994 International Conference on Population and Development in Cairo.

Despite earlier views that considered Guatemala's fertility transition stalled, recent data reveal a steady decline in fertility and a parallel increase in contraceptive use, particularly since the turn of the 21st century. Guatemala has increased public social spending since the Peace Accords of 1996, but the country still has a long way to go before its economic and social indicators match those of other comparable countries in the region. Future efforts to eradicate extreme poverty, redress the discrimination and marginalization of indigenous population, and to invest in youth's health and education will be crucial for shaping fertility trends and the well-being of future generations.

2.4.2 Venezuela

The transition to low fertility in Venezuela—from 5.0 children per woman in 1970 to 2.49 in 2010—has happened mostly through increases in levels of education and women's employment, and delays in the age of cohabitation or marriage. Venezuela's family planning policies were implemented during the transition to democracy after the end of the Pérez Jimenez dictatorship in 1958. However, family planning efforts never became particularly strong after promising efforts in the 1960s. Programs were restricted to public initiatives and were later embedded in more general health programs (Parrado 2000).

Venezuela's rapid economic development and modernization was closely tied to its export- and oil-based economy. Oil nationalization created the wealth that was conducive to fertility reduction, which is not the case for all oil-based economies as can be seen from the Algerian case. In the middle of the 20th century, Venezuela attracted a large number of migrants from Southern Europe (mainly Portugal, Italy and Spain), which led to the diffusion of smaller family norms and family ideals (Van Roy 1987).

Even though Venezuela is the most urbanized country in Latin America with more than 93 percent of the population living in cities (World Bank 2012), persistent differentials still exist by education and place of residence. While TFR is down to 1.9 in the Capital district, TFR was found to be as high as 4.9 in Delta Amacuro in 2010,[7] where the population is composed of indigenous people called the Warao.

2.4.3 Bolivia

Bolivia, one of the poorest countries in the region, belongs to the last group of Latin American countries to experience the onset of the fertility transition. According to the latest census (Instituto Nacional de Estadística (INE) 2013), the total population was 10.4 million, compared to only 2.7 in 1950. The country currently has one of the highest fertility levels, 3.5 children in 2008. The TFR was above seven children per woman in the first half of the 20th century and, as opposed to other countries in the region, remained at relatively high levels through the second half of the century. According to the UN (2011), the TFR stayed at five children through the nineties. It is only in the last decade (2000-2010) that Bolivian fertility showed significant signs of a decline.

Although the fertility transition has definitively started in Bolivia, there are no indications that the country will follow the Latin American pattern, especially because of two peculiarities regarding reproductive behaviour in the context of extremely wide socioeconomic gaps–consistently high teenage fertility and low contraceptive prevalence.

The fertility rate of women 15-19 was about 90 per 1000 women in 2008 compared to 70 at the regional level, having increased from the 2000 value of 85 (ECLAC 2010). The proportion of adolescents who are mothers among young women with a low formal education is nearly five times higher than that of young women who have received a secondary or higher education, according to data from 1998 and 2003. The same is true when comparing the lowest and highest wealth quintiles. This gap shows no signs of narrowing: in 2008, while the proportion of mothers in the wealthiest quintile was 5.5 percent, the equivalent proportion among the poorest quintile was 26.6 percent. The gap according to educational differences was even wider.

The absence of a sustainable fertility decline is also related to the relatively low prevalence of modern contraception. Whereas some neighbouring countries like Brazil show a near 80 percent prevalence rate in the use of modern contraception methods among married women, the prevalence in Bolivia was 35 percent in 2003 and in 2008. Once again, the disparities by education and wealth are significant, with twice as many women who use modern contraception among the secondary and higher educated women compared to women with less than secondary education. The same degree of

[7] According to the National Statistical Institute (2011).

difference is observed among the lowest and highest wealth quintiles. There is no evidence of a narrowing gap in recent years (DHS Bolivia 2009).

2.5 Conclusions

The experience of individual countries shows that if the transition to low fertility seems to be the general rule globally, its speed and intensity vary greatly across geographical areas (continents, countries, and sub-regions), cultural factors (religion, ethnicity), and socioeconomic characteristics (such as education, income, and place of residence) at the individual level. Other macro-level factors such as the political environment (active policy support for family planning) and the economic setting – for instance whether the economy is built on the exploitation of raw materials – are also key in explaining fertility declines.

While these examples document the diversity of fertility trends, they lack a theoretical framework with explanatory power. That framework is the aim of the next section, which will also allow evaluation of the potential future fertility trends in the different countries based on analysis of the current main drivers of change.

3 State of the Theory Explaining Past and Future Trends

3.1 Introduction

In the first part of this paper, we investigate country- and region-specific fertility patterns and trends. Although we identify considerable differences in their stages of demographic transition, within as well as across regions, almost all countries have entered at least the early stages of fertility transition. Although the speed of consecutive transition pathways is not known, research has shown that it depends on many factors, including improvements in infant and child mortality, changing norms and values of desired fertility, meeting the unmet need for family planning, further education progress, political reforms, and environmental pressure.

Demographic transition theory was developed to describe the passage of populations from the status of traditional societies where both fertility and mortality rates are high to the status of modern societies where both fertility and mortality rates are low. The model elaborated by Notestein in 1945, based on earlier work by Landry, consists of four stages: (1) Equilibrium at high fertility and mortality levels; (2) a phase of rapid population growth as death rates begin to fall because of improvements in living standards, food supply, and health, particularly declining child survival due to immunization and better hygiene; (3) a fertility decline that follows the mortality decline, which leads to (4) a stage of quasi-equilibrium between low birth and death rates (Notestein 1945).

Contrary to the European demographic transition that was long-lasting and accompanied by slow population growth, the transition from high birth and mortality rates to low birth and mortality rates in Asia, Latin America, and African countries started only in the second half of the 20th century. This transition was more rapid and accompanied by higher growth rates of the population, up to three to four percent per year, and is still underway in most developing countries.

The general trend toward declining fertility rates in the majority of countries is undisputed, and a large number of countries in Asia and Latin America have experienced substantial declines or even reached replacement fertility (Bongaarts 2008). However, the pace of the fertility decline in many countries in sub-Saharan Africa and South Asia has been slower than expected as socioeconomic development, a key driver of fertility decline stagnated for many decades (Bongaarts & Casterline 2013; Bulatao & Lee 1983). In particular, the process of demographic transition in sub-Saharan Africa and periods of stalling fertility are discussed among demographers (Bongaarts 2006; Schoumaker 2009). Current theoretical and empirical contributions to the field center around the question of whether we can observe an alternative type of fertility transition in Africa, as compared to transition pathways observed elsewhere (Bongaarts & Casterline 2013; Caldwell et al. 1992; Moultrie et al. 2012).

The underlying causes of sluggish fertility transitions in Africa are multidimensional. In a number of countries, the unmet needs for contraception are stalled at high levels because family planning programs received little attention at the beginning of the 21st century (Blanc & Tsui 2005; Cleland et al. 2006). On the other hand positive development can be observed, i.e. Rwanda committed to an extensive expansion of its family planning programs and educational efforts (Bongaarts & Casterline 2013; Westoff 2013), which led to rapid improvement of reproductive health indicators. Acknowledging the consequences of population growth and raising awareness at the national political level seems to be a powerful tool to improve women's and children's health in the long run. Also, following the London Family Planning Summit in 2012, international donor agencies recognized the undersupply of funds for programs supporting reproductive health and, as a result, new funding schemes are being established.

Nonetheless, from a theoretical perspective, it remains an open question whether conventional demographic transition theory can be applied to countries at the high ends of the current fertility spectrum, and if these countries will ever converge to levels around replacement fertility. In their recent contribution, Bongaarts and Casterline argue that family size ideals in almost all countries in sub-Saharan Africa are higher than in other countries at similar stages of fertility transition in Asia, Latin America, or North Africa. Also, fertility transition is slower than observed elsewhere (Bongaarts & Casterline 2013). In contrast, fertility in Addis Ababa had already reached below replacement levels at the turn of the 21st century (Sibanda et al. 2003). Thus, the variation in demographic indicators, historical and political circumstances – within and across countries, regions, and ethnicities—is notable.

The next section identifies the most important determinants and conditions for further fertility decline across high fertility regions and assesses their relevance for expected future fertility trajectories. We start with a section on stalling fertility, followed by the impact of family size ideals, and matters of reproductive health, female autonomy, economic circumstances, and the impact of policies. Given the importance of education mediating a vast majority of factors relevant for fertility decline, each part will specifically refer to the role of education as a driver of fertility change. The last section will introduce empirical evidence of differential fertility by educational attainment. This review of theoretical and empirical literature created the theoretical basis for designing the questionnaire which will be introduced in the subsequent section.

Box 1: Stalling Fertility

Fertility stalls, corresponding to an interruption of the fertility decline before the end of the transition, were until recently considered rare (Bongaarts, 2006). In the last fifteen years, however, the number of countries experiencing stalls has grown substantially, even though the genuineness of several of these stalls has been debated (Machiyama, 2010; Schoumaker, 2009).

Early literature on this topic described stalls in Costa Rica and South Korea (Gendell, 1989, 1985) 1989). More recently, stalls or reversals of fertility declines, have been found and analysed in a variety of countries. Bongaarts (2006) identified seven developing countries with stalling fertility in the 1990s, namely Bangladesh, Colombia, Dominican Republic, Ghana, Kenya, Peru, and Turkey. The list of countries with fertility stalls increased quickly in the early 2000s, with new surveys showing interruptions in fertility transitions in sub-Saharan Africa. As of today, as many as 14 sub-Saharan African countries have experienced stalls in fertility transition, although the list of countries varies according to the authors and the methods used to identify stalls (Bongaarts, 2008; Garenne, 2007; Machiyama, 2010; Schoumaker, 2009; Shapiro and Gebreselassie, 2008). Stalls have also been described in Egypt (Eltigani, 2003) and Jordan (Cetorelli and Leone, 2012). In short, stalls no longer appear to be an exception.

Research on the causes of stalls in fertility transitions has focused mainly on the influence of family planning programs, the role of demand for children (desired family size), and the impact of socioeconomic development. Overall, studies on the causes have provided mixed results and, as stated by Moultrie et al., "no consensus exists about the causes of such stalls" (2008: 44).

The role of family planning programs has received considerable attention and generated diverse findings. Gendell (1985) noted the deterioration of the family planning program in the late 1970s as a possible cause for the long stall in Costa Rica during that period. Recent studies in sub-Saharan Africa have suggested that shortages of contraceptive supplies (in Kenya, see Westoff and Cross, 2006) and slowdowns of investments in family planning programs were partly responsible (on Ghana, see Agyei-Mensah, 2007; on Kenya and Tanzania, see Ezeh et al., 2009; Sinding, 2008). In contrast, Bongaarts' study (2006: 13) on the causes of stalls in seven countries concluded that there is "little support for the hypothesis that declining access to contraception is a main cause of stalling fertility".

The demand for children (desired family size) has been shown to be correlated to fertility stalls in several contexts. Bongaarts (2006) found stalls in decreases of wanted fertility in the seven countries of his study. In one of these countries, Kenya, Westoff and Cross (2006) also showed a reversal in the declining trend of desired family size. In Egypt, Eltigani (2003) highlighted a stall in desired family size as a possible explanation. However, the reasons for the stalls in desired family size are not, themselves, fully understood. In Kenya, increasing child mortality may have changed fertility preferences and contributed to the stall (Westoff and Cross, 2006). In some countries, desired family size may also be influenced by preferences for sex composition, which contributes to stalls. For instance, Menken et al. (2009) suggest

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that in Bangladesh the "desire for at least one child of each sex, especially boys, and a preference for two boys and a girl may have inhibited the fall in fertility".

Regarding socioeconomic development, no clear pattern has emerged from research. In some countries, for example Kenya, stalls in fertility corresponded to levelling off in development as measured by GDP per capita, female schooling, and child survival (Bongaarts, 2006). Yet, other countries (e.g., Turkey and Bangladesh) have experienced stalls while socioeconomic development was proceeding apace (Bongaarts, 2006). In sub-Saharan Africa, Garenne (2007) found mixed results regarding the relationship between fertility and GDP growth in the cases of stalling fertility.

Finally, another possible "explanation" for the stalls, especially in sub-Saharan Africa, is that they are spurious. This hypothesis was explored in sub-Saharan Africa by Schoumaker (2009) and Machiyama (2010). According to these authors, several of the stalls actually reflect data quality problems (omissions and displacements of births and problems with sampling frames across surveys). The most obvious example is Nigeria, where the stall between the late 1990s and early 2000s is almost certainly due to a substantial underestimation of fertility in the late 1990s.

What do these stalls imply for the future of the fertility transition? In most cases that have been studied, stalls lasted 5-10 years, followed by a renewed fertility decline. Hence, stalls appear as relatively short breaks in the course of the transition, delaying the time when these countries reach low fertility. Given that some countries were advanced in their fertility transition before the stall (their fertility was lower than expected as predicted by their level of development, see Bongaarts 2006), countries that have experienced fertility stalls are not necessarily late in their transitions compared to other countries. Still, relatively long stalls have been identified in some countries (for Jordan, see Cetorelli & Leone 2012) and should these stalls last, their impact on population growth could be significant.

3.2 Desired Family Size and Ideational Change

Early stages of demographic transition are characterized by declining rates of infant and child mortality. Assuming that parents are seeking to optimize their number of surviving children, they adapt to increased survival of their offspring by adjusting the number of live births. This process has been extensively described in most countries that have undergone the transition (Dyson 2010a). Families plan their children sequentially, often only after they have already experienced birth, illness and death, and have learned about their own fecundity. Women in societies little influenced by family planning through mass media, social workers, or their network of peers often answer the question about their desired family size with 'up to God,' or give unreasonably large numbers of children they consider as optimal. Although researchers have challenged this concept of "natural" fertility (Mason 1997) and argued that pre-transitional societies have controlled fertility well before entering the process of industrialization and modernization (Coale & Watkins 1986), fertility desires remain an important determinant for predicting actual fertility.

The relationships between education, fertility desires, and actual fertility are well documented (Castro Martin & Juarez 1995; Castro Martin 1995; Cochrane 1979; Jejeebhoy 1995). Women with some but less than primary education at the beginning of the demographic transition experience lower rates of foetal mortality and better levels of health in general and thus show even higher levels of fertility than women with no formal education at all. In contrast, women with at least completed primary schooling incorporate fewer child deaths into their planning and behaviour and, in addition, consider fewer children as desirable. Educational differences in fertility can be observed throughout the demographic transition and tend to be larger in early rather than in later stages of the transition. An important relationship is that women with higher educational attainment are, on average, better able to exercise family planning and control their fertility (Hayford & Agadjanian 2012). Unwanted children and education are inversely related (Bongaarts 2003).

In a transitional society, attitudes toward children change mainly through the import of Western culture through two main vehicles: mass education and the mass media. Caldwell (1982) distinguishes between modernization and Westernization noting that Westernization may occur before or without modernization. Sri Lanka is an example of a country where fertility and mortality have both experienced substantial declines due to the Westernization of institutions, values, and aspirations without a corresponding degree of economic modernization. The presence of mass education in a country will increase the impact of education in lowering fertility rates. In those countries, even a small amount of education will be associated with a decline in fertility. The introduction of mass education is a sign of a changing society moving toward modernity in the Western sense of the word—an industrial, urban, monetized economy with lower community child-bearing norms.

For decades it had been argued that compared to other world regions, women and men in sub-Saharan Africa show unusually high numbers of desired children and exceptionally high levels of actual fertility. Nonetheless, in African countries with still high levels of fertility, women with some degree of education desire fewer children than their uneducated counterparts. To the extent that the process of fertility decline can be regarded as a diffusion of new, progressive ideas and modes of behaviour, the existence of substantial group differences in fertility may be temporary, and without profound theoretical significance. It is hardly surprising that those segments of the population most exposed to new ideas, by reason of their education or geographical location, will form the vanguard of change (Bongaarts 2011). Thus, theoretical considerations about the determinants of desired family size and their interaction with educational attainment still hold for sub-Saharan countries, even if desired family size has been higher than in Western countries before they entered the fertility transition. These levels could converge to levels higher than replacement fertility.

Modern theories of fertility transition explicitly incorporate the idea of ideational change (Cleland & Wilson 1987; Lesthaeghe & Surkyn 1988), and the spread of norms and ideals within and across societies. Cultural factors, family organization, and parents' education are more important for the diffusion of new family ideals than economic well-being and female employment. Beyond investigating micro level characteristics of women and men, it is important to analyse higher order characteristics including peers in the community, regional factors, ethnicity, and country-specific indicators. These higher order characteristics enhance the predictive power of fertility

transitions. Empirically, the challenge is, "to find out whether education at the aggregate level has any effects on a woman's fertility above and beyond that of her own education" (Kravdal 2000, p.2). The importance of mass education creates a "spill-over" from other people's education so that, for instance, uneducated women living in an educated society could have different fertility behaviour than uneducated women living in an uneducated society. Hence, the depressing effect of education on fertility could be stronger than individual data on women's education would suggest, through the effect of aggregate education.

In recent years, a large body of empirical research has focused on the transmission of changing norms and ideals. It has been shown that family size norms and ideals tend to spread within and across all societal clusters and should always be considered when analysing fertility behaviour. Social learning is relevant for contraceptive prevalence (Kohler 1997), proximity to schools and ethnicity have effects on fertility (Axinn & Barber 2001), and local, regional and global interactions affect the global fertility transition (Bongaarts & Watkins 1996; Kravdal 2012; Kravdal 2002; Kravdal 2000; Moursund & Kravdal 2003; Rosero-Bixby & Casterline 1993). .

Regarding family planning programs, mass media are frequently employed for changing attitudes toward contraception. A recent study by Mwaikambo and colleagues (Mwaikambo et al. 2011) provides an extensive review of family planning programs and their success in changing knowledge, use, and attitudes regarding contraception. Employing mass media for information, education, and communication (IEC) has proven to be a successful strategy of inducing behavioural change towards contraception and "talk down fertility" (Robinson & Ross 2007). Since the 1970s, the effectiveness of family planning programs has greatly improved. Some early family planning programs were poorly managed and offered few alternatives to sterilization (see India, Nepal, etc.). As a result, together with failing political commitment, many programs did not succeed initially. Nonetheless, carefully designed programs appropriately embedded in social settings and respecting cultural frameworks are still considered state-of-the-art measures that can trigger changes in attitudes towards modern means of contraception and bring down actual fertility. A recent study of 40 countries with high fertility indicates that about half of the difference in birth rates across countries can be attributed to family planning efforts. Family planning programs are most successful in favourable social settings with already decreasing infant mortality rates and improving female education. However, the effects of family planning programs, education, and infant mortality on fertility weaken in settings outside of sub-Saharan Africa, where fertility rates are lower on average (Jain & Ross 2012).

Concerning the literature on religion's impacts on fertility, three main classical paradigms introduced by Goldscheider (1971) and others are in competition. The first, the "characteristics approach", denies the existence of a link between religious affiliation and fertility and assumes that other socioeconomic factors such as education and place of residence predominantly explain changes in fertility within and across countries. The fertility decline in European countries and Turkey are examples of this approach. This is consistent with the finding that religion loses influence once the fertility of couples is within the calculus of conscious choice (Van Poppel & Derosas 2006). A second paradigm, the "particularized theology hypothesis", emphasizes the influence of teaching and spread of values related to fertility behaviour for explaining

fertility differences (McQuillan 2004) that remain after controlling for socioeconomic factors. It has been shown that religious intensity plays an important role in explaining fertility differences, with highly religious people being more likely to want and have more children than less religious and secular people. The reasons for this go beyond religion teaching to the impact of social networks and social capital (Adsera 2004; Philipov & Berghammer 2007). A third paradigm, called the "minority status hypothesis", emphasizes that communities that are a minority in a country may adopt a particular fertility behaviour (Day 1984; Goldscheider & Uhlenberg 1969), as shown by Muslims in India (Kulkarni & Alagarajan 2005) and the Palestinian territories, or Catholics in Northern Ireland. Given competing hypotheses at play, it remains unknown if, where and when religions and religious beliefs will play an increasing role in shaping future fertility in high fertility countries.

The range of fertility levels in the set of high fertility countries is huge. Fertility ranges from slightly above or above replacement level to fertility close to 7. While many countries are still in the early stages of fertility transition and struggle with low levels of female education, high infant mortality and high desired family size, there is a range of countries in all parts of the world, including Peru, Colombia, Morocco, Algeria, India, and the Philippines, that experience levels of fertility below 3. They are most likely to attain replacement fertility in the next decade, and as a result a different set of factors will be important for continuing fertility decline than the drivers in the highest fertility countries. Postponement of parenthood and non-marital childbearing—indicators of the second demographic transition (Lesthaeghe 1995; van de Kaa 2001; van de Kaa 1987)—are expected to gain momentum in countries now close to replacement level fertility. Nonetheless, even though fertility has reached low levels in countries like India and the Philippines, cultural components of fertility preferences (such as son preference) and ideals should be considered carefully when predicting further fertility decline.

3.3 Health and Reproductive Health

Davis and Blake (1956) analysed the biological and behavioural dimensions of human fertility. They linked the two dimensions through a set of proximate determinants or intermediate fertility variables. These proximate determinants have a direct influence on fertility. Socioeconomic factors and health and nutrition influence the proximate determinants. Education was found to influence controlled fertility through its proximate determinants: marriage, contraception, and induced abortion. This framework was further used and extended by Bongaarts (1980) and Bongaarts and Potter (1983). In a study of eight countries, Bongaarts and Potter found marital fertility to be lowest among better educated women but with some notable exceptions, e.g., among women with no education in Kenya and Indonesia. Higher education is associated with later age at marriage and increased contraceptive use in all studied countries.

Since the seminal work of Caldwell in Nigeria (Caldwell 1979), the relationship of education to infant mortality has been subject to a great deal of research, which has found, in part, that favourable child health outcomes are generally positively correlated with female education (Hobcraft 1993; Mensch et al. 1985). As a consequence of the negative association of foetal mortality and female education, it had been shown that in selected countries, women with some education show higher rates of fertility than

women without formal education (Jejeebhoy 1995). Clearly, living in a wealthier, more developed environment with better health services and improved sanitation increases the chances of child survival. Nonetheless, recent literature shows that education of the mother and women in the community has a stronger effect on infant health outcomes than household income and community wealth (Pamuk et al. 2011). Thus, with increasing proportions of women gaining access to formal education, positive diffusion effects from living in a better educated community can be expected to further boost the speed of mortality decline.

Given the predictive power of infant and child mortality for the fertility transition, it is of particular interest to observe recent developments in this area. A recent study by Rajaratnam and colleagues (2010) collects data from all available sources on infant and child mortality from 187 countries since the 1970s. The researchers find accelerating rates of mortality decline from 2000 to 2010, compared to the period from 1990 to 2000 for many world regions, including sub-Saharan Africa. Only in countries with high prevalence of HIV/AIDS in Southern Africa (South Africa, Swaziland, and Lesotho) do they find oscillating and even increasing rates of under-five mortality. Countries in Latin America and North Africa show the fastest rates of decrease in the period from 1970 to 2010, while yearly declines have been smaller in South- and Southeast Asia and smallest in sub-Saharan Africa. Comparing the share of neonatal deaths to infant and child deaths worldwide, regions with low child mortality are characterized by a high share of neonatal births out of the total number of child deaths. Only in Africa does the proportion of infant and child deaths caused by pneumonia, malaria, diarrhoea or other infectious diseases remain above 70 percent and 62 percent, respectively, as a proportion of all deaths (Black et al. 2010). Nonetheless, these findings confirm the general trend of decreasing child mortality and in turn, suggest further reductions in fertility. While countries in Southern Africa are challenged with the HIV/AIDS epidemic, most countries in East and West Africa have experienced steadily decreasing infant and child deaths.

Elements of the proximate determinants of fertility as defined by Bongaarts (1987) are closely linked to marriage patterns in early stages of fertility transition. Demographic transition theory predicts increasing levels of age at marriage. Child marriage (marriage under 18) is associated with an increasing level of mortality and morbidity of children under five, but also leads to high levels of fertility, multiple unwanted pregnancies, higher levels of pregnancy termination, and sterilization (Raj et al. 2010; Raj et al. 2009). These results persist when controlling for socioeconomic characteristics. Still, a majority of women who married before the age of 18 receive little to no education and live in the poorest households. Empirical evidence shows slowly increasing age at first marriage in many, but not all, high-fertility countries in sub-Saharan Africa (Marston et al. 2009; Westoff 2003). Age at first marriage remains a valuable indicator leading to further improvements in under-five mortality and reproductive health.

While the proportion of teenage marriage is consistently declining in Latin America, age at first birth is stable or even declining in some Latin American countries (Colombia and the Dominican Republic). Even though both the availability of contraception and educational attainment have increased, adolescents are now more sexually active (Blanc et al. 2009; Westoff 2003). In contrast to Latin America, trends in the percentage of unmarried, sexually active females aged 15-19 are down in many

countries in sub-Saharan Africa in recent decades (Blanc et al. 2009), although sexual activity is increasing among 15-19 year olds in Ghana, Mali, Nigeria, Ethiopia, and Madagascar. Sexual activity is negatively related to female education but shows no clear association with male education (Doyle et al. 2012). Contraceptive prevalence has grown faster for adolescents than for older women, but reported method failure discontinuation rates are higher. Women who are sexually active but unmarried are more likely to use contraception than their married counterparts. Still, most adolescent sexually active women are married (Blanc et al. 2009). Through increasing contraceptive use together with lower desired family sizes, today's young cohorts from high-fertility backgrounds may well display distinct patterns of contraceptive use and thus fertility behaviour throughout their reproductive careers, compared to their mothers' generation. In Latin America, adolescents are freeing themselves from traditional marriage patterns by showing increasing rates of sexual activity and childbearing outside of marriage. In sub-Saharan Africa and Asia, the general pattern is less clear but many indicators are moving in the same direction.

Research shows that in regions with high prevalence of unmet need, high abortion rates prevail (Westoff 2006). From 1995 to 2003 as unmet need has declined worldwide, abortion rates have therefore fallen. The majority of abortions (55 percent) are unsafe in developing regions, including 38 percent in Asia, 94 percent in Latin America and 98 percent in Africa (Sedgh et al. 2007). Highly restrictive abortion laws are generally not connected to low abortion incidence; instead, abortion is practiced unsafely. The root cause of abortion is unintended pregnancy, and there is a clear correlation between increasing contraceptive use and declining rates of abortion. Unsafe abortion laws can lead to a high burden of maternal deaths that can be several hundred times higher than if abortion is performed professionally under safe conditions (WHO 2004). Meeting the unmet need for family planning in high fertility countries will thus potentially lead to lower abortion rates and declining maternal mortality caused by unsafe abortion. In general, maternal mortality has declined substantially from 1980 to 2008 worldwide (Hogan et al. 2010). Factors associated with lower maternal mortality—decreasing fertility, higher income, better sanitary and health conditions, female educational attainment, and higher proportions of skilled birth attendance—have been improving on a global level, albeit region and country specific variations persist. HIV/AIDS, in particular, is putting pressure on economic development in Southern Africa.

Box 2: The Unmet Need for Family Planning

Women with "unmet need for contraception" are those who want to avoid pregnancy (at least for the time being) but are not using contraception. These are women at risk of an unintended pregnancy, either mistimed or unwanted.

Although the concept of unmet need is straightforward, measurement is complicated because the concept joins together fertility preferences and contraceptive use, and hence estimates of unmet need are derived by comparing survey responses on preferences and use. Additional challenges are posed by women who are pregnant or amenorrheic at the time of the survey. The estimation approach should accommodate these women because unintended pregnancies are the outcome of unmet contraceptive need. And the estimation approach must also allow for the fact that women who are sexually inactive or infecund do not have contraceptive need. (For detailed discussion of the measurement task and the current approach used by the DHS, see Bradley et al., 2012). Usual practice is to distinguish unmet need for *limiting* fertility (i.e. absence of contraceptive use among those who wish to have no more children) from unmet need for *spacing* (i.e. absence of contraceptive use among those who wish to postpone the next birth). The potential impact on fertility of satisfying unmet need for limiting is probably far larger than the impact of satisfying unmet need for spacing (Bradley et al., 2012).

The global percentage of currently married women who have unmet need (limiting and spacing), according to recent UN estimates (Alkema et al., 2013), was 12.3 percent in 2010. This is a 3.1 percentage point decline from the estimate of 15.4 percent for 1990. In 2010 among sub-regions consisting largely or entirely of countries not yet post-transition, unmet need was lowest in South America (8.9 percent) and Central America (12.0 percent), and highest in Eastern, Middle, and Western Africa (26.3 percent, 26.1 percent, and 25.9 percent, respectively). Unmet need is far more common in sub-Saharan Africa than in other regions, with more than one-half of sub-Saharan African countries (28 out of 48) having more than one-quarter of currently married women with unmet need. Outside of this region, sub-regional averages are less than 20.0 percent. But certain countries in other regions also have high unmet need, including Afghanistan, Nepal, and Pakistan in Southern Asia (29.5 percent, 26.3 percent, and 25.9 percent, respectively), Timor-Leste in Southeastern Asia (29.0 percent), and Guyana and Haiti in the Caribbean (29.4 percent and 35.5 percent, respectively). According to the UN estimates, in the period from 1990 to 2010, unmet need declined in all sub-regions with the notable exception of Western Africa. As would be expected, variation in rates of unintended fertility follows the same pattern across regions and countries (Singh et al., 2010).

The relatively low levels of unmet need outside of sub-Saharan Africa are the result of substantial decline over the past few decades, as is plainly evident from the UN estimates (Alkema et al., 2013) and from within-country comparisons of successive DHS surveys (Bradley et al., 2012). It is important to appreciate that trends in the prevalence of unmet need are typically not monotonically downward. Instead, unmet need often declines only slightly for an extended period of time, and sometimes increases slightly, before experiencing a steady and marked decline (Bongaarts et al., 2012). The initial resistance to decline occurs where change in fertility preferences –

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decline in the desired number of children – proceeds as rapidly (or more rapidly) as contraceptive adoption, resulting in an initial stage of fertility transition during which the fraction of women who wish to avoid pregnancy but are not using contraception remains relatively stable over time, despite an increase in contraceptive prevalence. In fact, DHS surveys reveal that this has been a common pattern in sub-Saharan Africa countries during the past two decades (especially in Western Africa).

Whatever the trends in unmet need, increasing contraceptive prevalence by satisfying unmet need results in fertility decline, *ceteris paribus*. Among the countries with a recent DHS, entirely (and instantaneously) eliminating unmet need for limiting would, hypothetically, reduce fertility (TFR) by one-quarter, with the fertility reduction ranging from one-tenth in West and Central Africa, the Middle East, and North Africa, to one-third in the Latin American and Caribbean countries (Bradley et al., 2012). These estimated reductions are based on the country-level regression relationship between contraceptive prevalence and the TFR. Alternatively, employing more sophisticated reproductive models, one can project a gradual satisfaction of unmet need and calculate the resulting impact on both the TFR and total population size. Moreland et al. (2010) performed this exercise for the developing world and calculated that satisfaction of unmet need would result in a TFR that, as of 2050, would fall below the UN Medium Variant projection (TFR=1.65 if unmet need is satisfied, as against TFR=2.05 under Medium Variant), and total population in 2050 that would be about 300 million smaller (5.97 billion if unmet need is satisfied, as against 6.27 billion under the Medium Variant). That is, meeting unmet need is a more than sufficient means of achieving the UN Medium Variant projections of fertility and population size. By any calculus, the potential demographic consequences of substantial reduction in unmet need are enormous (Bongaarts et al., 2012; Singh and Darroch, 2012). How to achieve reduction in unmet need? Improving access to family planning services (preferably low cost and high quality) is the most direct programmatic strategy, and there is little doubt that in many settings this has been, or could be, the key (Bongaarts et al., 2012). However, lack of convenient access to quality family planning services is but one of the obstacles to contraceptive use that have been identified through in-depth research on the causes of unmet need (Bongaarts et al., 2012; Casterline and Sinding, 2000). Other major obstacles include:

- Lack of knowledge of modern contraception, of where to obtain supplies, of how to use contraception;
- Belief that contraceptive protection is not required (e.g. low perceived risk of conceiving);
- Health concerns, especially fear of side effects from using contraception but also fear of infertility;
- Opposition from husbands and other family members;
- Concerns about the social and moral acceptability of practicing contraception

3.4 Status of Women in Family and Society

Karen Oppenheim Mason (1987) describes the impact of female autonomy on the supply of and demand for children, as well as on contraceptive uptake. She argues that

the societal position of women is affecting all dimensions of reproductive behaviour, including nuptiality, breastfeeding, gender preferences of children, the value and cost of children, and the use of contraception. Many of these factors involved in fertility decisions are closely related to female educational enrolment and attainment. Female education acts as a driver for autonomy and changing fertility decisions. On the supply side of fertility, education is expected to increase women's influence on fertility decisions and decrease the probability of an arranged marriage. Age at marriage tends to be higher for romantically contracted marriages. School enrolment may prevent arranged marriage by altering women's attitudes towards marriage, as well as their desired family size. Furthermore, the size of dowry or other marriage-related expenses is positively associated with female education, so that the age of marriage increases through the need to accumulate sufficient assets.

On the demand side of fertility, female autonomy acts through many different channels. For one, the existence of gender preferences in fertility behaviour is expected to be stronger in societies with lower female autonomy (Das Gupta et al. 2003). Thus, son preference can be an influential driver in raising the desire for another child (Jayaraman et al. 2009). Also, bearing children, and especially sons, is often connected to an improved position of women in family and society. Probably one of the most important factors relates female autonomy to the costs of children. It had been argued that the concept of opportunity costs may not apply to women in the least developed countries because women employed in rural, agricultural jobs often bring along their children or have family child care available, while domestic servants take care of minors of women employed in modern sector jobs (Mason Oppenheim 1987). In light of a globally changing environment, rapid rates of urbanization and increasing female educational attainment, this line of argumentation will not necessarily hold for future generations of women in today's highest fertility countries.

Female autonomy and gender equality are associated with a more egalitarian husband-wife relationship. Spousal communication is often limited (Ijadunola et al. 2011), with men preferring shorter birth intervals than women (Gebreselassie & Mishra 2011). However, women with greater decision autonomy are more likely to discuss family planning with their partners and experience higher rates of contraceptive prevalence (Link 2011). Many studies have shown that female autonomy and education translate into lower fertility rates (Jejeebhoy 1995; Moursund & Kravdal 2003; Saleem & Bobak 2005). To ensure further improvements in female autonomy and gender equality it will be important to close the gender gap in educational attainment globally.

While education does not automatically guarantee an improved standing of women vis-à-vis their partners and families, it can act as a mediating variable and trigger ideational changes in the society as a whole. Although a little education can make a difference in desired family size and actual fertility outcomes, providing only primary education will not be sufficient for sustainable progress in gender equity (Jeffery & Basu 1996).

3.5 Economic Costs and Benefits

Through the work of Easterlin and Crimmins (Easterlin 1975; Easterlin 1983; Easterlin & Crimmins 1985), fertility transition and behaviour was placed in a market context, where children enter the model as consumption goods (Schultz 1997). They single out

one subset of proximate determinants having to do with deliberate fertility control variables while deemphasizing exposure to intercourse, fecundability, duration of postpartum infecundability, spontaneous intrauterine mortality, and sterility. Instead, they emphasize regulation costs and demand and supply, thereby introducing links between modernization and fertility. In their approach, all the determinants are assumed to work through three categories: the demand for children, the supply of children, and the costs of fertility regulation.

Education is recognized by the two authors as the most pervasive factor influencing fertility control behaviour, compared to other factors such as rural-urban residence, occupational structure, wives' work status before marriage, innovations in public health and medical care, urbanization, and the introduction of new goods. Education operates on all three of the intervening variables, in the following ways:

(a) On the supply of children: Although education increases age at marriage, it also breaks down traditional beliefs (e.g., postpartum and lactational abstinence, as well as customs such as long duration breast-feeding) that increase birth spacing and limit fertility. Education also improves health conditions by diffusing improved knowledge, which lowers child and maternal mortality, and it leads to a higher standard of childcare, with more emphasis on child quality than quantity.

(b) On the demand for children: Education shifts preferences away from a large number of children and decreases the price of goods relative to children; it improves the income-earning possibilities of women and thus increases the opportunity cost of the mother's child-rearing time; it increases the relative cost of children by reducing the possible contribution of child labour to family income; it decreases the intensity of the desire for children (associated with "old goods") relative to new goods (new life styles put forward by education). It also decreases the preference for sons over daughters.

(c) On the costs and obstacles to contraceptive use: Education increases information about various means of fertility control, alters cultural norms opposed to the use of fertility control, and increases spousal communication.

Caldwell's research on "wealth flows" stresses factors affecting the demand for children (Caldwell 1982). He argues that fertility decline began when there was a reversal of the net flow of resources from parents to children, rather than from children to parents. This economic change was the result of social changes that concentrate greater family concern on the children. Hence, it is often argued that in the absence of pension systems and social security networks, healthy, surviving children guarantee old age support and the wealth flow from children to parents would persist. Thus, as long as no pension schemes are implemented, couples would not feel safe limiting their fertility. While there are discussions of whether declining fertility is causing policymakers to establish public pension systems or vice versa (Entwisle & Winegarden 1984), fertility regimes in Africa differ from developed countries in their kinship systems, social organization, polygyny, child-fostering, and related characteristics, such that conventional demographic transition theory may not apply (Lesthaeghe 1989). Certainly, development of social security networks and pension regimes entails positive effects on old age morbidity and mortality; however, it is not clear whether such reforms are necessary to bring down fertility in the currently high-fertility countries.

Since Gary Becker's contributions on the trade-off between quantity and quality of children (Becker et al. 1960; Becker 1991), the association of the demand for children with respect to income has been an integral part of explaining the shifting demand for children with rising income. While early demographic transition theory focused on the aggregate level of development and modernization, Becker offered a new approach focusing on individual preferences for children. In this approach, the utility function parents seek to maximize depends indirectly on the price of children relative to the price of other commodities. Partly because the costs of children are less in rural than in urban areas due to lower costs of food and housing, family sizes in rural areas are larger than in urban areas. As populations become richer and better educated, positive income effects are counteracted by rising opportunity costs of women gaining higher education and working in the labour market, thus raising the relative costs of rearing children. Becker thereby relates declines in fertility to income growth and especially the earning power of women.

Following Becker, economists usually argue that income and the cost of children are the most important factors in shaping future fertility. A related recent contribution hypothesizes that the changing demand for human capital in the course of modernization and technological change has been an important cause of smaller family sizes (Galor, 2001). In addition, globalization is causing high degrees of specialization in the production process, requiring a highly skilled labour force. The production of unskilled goods is outsourced to developing countries, where, as a consequence, incentives to educate the labour force are missing and fertility remains at high levels (Galor 2011). This market pressure, caused by international division of labour, is a factor typically not accounted for in classical demographic transition theory.

Differences in fertility by income are observed worldwide. While there is a negative association for most developing countries, patterns of U-shaped fertility are observed in several developed countries. Since the correlation of educational attainment and income is high in general, it is hard to disentangle the effects. The educational gradient tends to be steeper than the income gradient, and the causal mechanism of positive and negative income effects as drivers of fertility in the course of demographic transition are still disputed. The Princeton Project investigating the decline of fertility in Europe emphasized the role of changing norms and values and diffusion of new ideals rather than income as most important factors in fertility decline (Coale & Watkins 1986).

3.6 Other Factors

Many developing countries are facing rapid and uncontrolled urbanization. Deforestation, droughts, population pressure, education, and poverty are among the causes, compelling individuals search for a better life away from rural areas. The consequences of urbanization for fertility remain unclear. On the one hand, fertility in urban areas was traditionally connected to lower levels of infant mortality, desired fertility, and actual fertility. Indeed, health outcomes in urban areas, even in poor urban settlements, often indicate improvements due to upgraded infrastructure, e.g. water and sanitation (Butala et al. 2010). On the other hand, unplanned migration to urban areas without public infrastructure and any provision of government services will result in subpopulations vulnerable to infectious diseases and extreme climatic events.

Accordingly, informal settlements of Nairobi experience higher rates of infant mortality than rural areas (Patel & Burke 2009). Even when the cost of raising children in urban settings is high and housing scarcity discourages couples from raising children, modern values and ideals may not diffuse rapidly in the poorest socioeconomic communities, for example in the shantytowns of Africa. Future impacts of urbanization on fertility will thus depend strongly on political commitment of urban planning and servicing of women and couples migrating to urban settlements.

Box 3: A Policy Perspective

After World War II, government efforts in developing countries were geared at reducing high mortality levels, especially for infants and children. These efforts were initially focused on public hygiene (e.g., sanitation and water adduction) but evolved later into programs aimed at controlling, and sometimes eradicating, specific diseases (e.g., smallpox). Thereafter, governments launched large immunization campaigns (e.g., against poliomyelitis) with considerable logistical means and funding levels. These programs helped to improve health outcomes and reduce mortality levels.

The survival of large numbers of people as a result of sanitation and disease control accelerated the rate of demographic growth. In many developing countries, fertility levels were still high and there was no indication that they would decline in the foreseeable future. These demographic trends lasted until the late 1960s and made more compelling the need to address the issue of rapid population growth and high fertility, particularly in Asia. Several vanguard countries, such as Japan, enacted fertility reduction measures or, in the case of India, initiated broad family planning programs (India prepared the first formal population policy in 1952[1]). Other countries, mostly in Asia, launched family planning programs as well. International know-how and funding – under what is known as the *Population Movement* – helped to expand these programs, which became better organized and widespread in developing countries. This heralded the beginning of the worldwide contraceptive revolution, which occurred in most regions with the exception of the least developed countries (LDCs) and, in particular, sub-Saharan Africa. In sub-Saharan Africa, political leaders deemed that socioeconomic development was the foremost priority. As a result, these countries did not launch organized family planning programs as had been done in Asia, Latin America, and the Caribbean.

These family planning programs succeeded in reducing fertility levels by a factor estimated to be between half a child and one and a half children. However, family planning programs were not successful everywhere. In Pakistan, for instance, efforts to reduce fertility failed initially, whereas similar efforts succeeded in Bangladesh (which was part of Pakistan until 1971). It became clear that family planning programs *per se* were not sufficient to trigger fertility declines and needed to be complemented by broader interventions, such as female education and female participation in the labour force. Moreover, policymakers sometimes became frustrated by the lack of progress of family planning programs, to the extent that they resorted to coercion. This happened in India in 1975-77 during the Emergency period and when China enacted the one-child policy in 1979. Concomitantly, feminists and women groups led a growing concern about the issue of human rights as a fundamental prerequisite for socioeconomic development. This reproductive rights

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movement gained pre-eminence internationally in the late 1980s and early 1990s.

The main paradigm shift occurred at the 1994 International Conference on Population and Development (ICPD) in Cairo, Egypt, where an agenda was crafted based on reproductive rights and reproductive health (human rights in the area of reproduction had already been highlighted in the Tehran International Conference of 1968). However, after the Cairo Conference, the contraceptive revolution lost its initial momentum (this was caused in part by the success of family planning programs in several countries, which led donors to turn to other priorities). Moreover, family planning suffered from the vagaries of US domestic politics (linked to the debate about abortion), such that family planning became a contentious issue internationally and the US withdrew funding to the United Nations Population Fund (UNFPA). In the early 1990s, the international community also became concerned with a host of new issues, such as the HIV/AIDS epidemic, good governance, climate change, and the food crisis. As international assistance was redirected to combat the threat of HIV/AIDS, family planning programs became less adequately funded. In addition, the Millennium Development Goals (MDGs) adopted in 2000 did not include family planning (this was done only in 2005, with the addition of Target 5b to achieve, by 2015, universal access to reproductive health). Today, there are still about 222 million couples in need of family planning services (Guttmacher Institute's estimate of 2012).

At the July 2012 London Summit on Family Planning, the international community formally pledged to rekindle its efforts in this critical area. To that end, a number of countries, mostly the least developed countries in sub-Saharan Africa, need either to trigger a fertility decline or accelerate their on-going fertility declines, which have generally been very slow. In this respect, Western and Middle Africa are the sub-regions where the needs are the greatest. In order to make a difference, voluntary family planning will need to be complemented with far-reaching interventions in the areas of female education, female empowerment and autonomy, and youth employment. Moreover, social norms favouring high fertility levels will need to change as well. A major additional challenge will be the coordination of the support, technical and financial, provided on the ground by a host of donors and stakeholders. Finally, the development framework that will replace the MDGs after 2015 will need to highlight the need for expanded access to family planning services, as this remains an unfinished agenda.

To conclude, policy efforts in the area of population and development will need to be pursued consistently and over several decades. The implementation of these policy efforts cannot be accomplished without a strong commitment on the part of the leadership of individual countries. Several sub-Saharan Africa countries have now embarked on broad and organized family planning programs with some success, as was demonstrated recently in Rwanda. It is only by acting with a sense of urgency that one might hope to reach a stage of sustainable demographic growth in a timeframe of two or three decades.

3.7 The Impact of Education in the Course of Demographic Transition – Empirical Evidence

In the framework of the demographic transition, education received much attention because it was found to increase the likelihood and the pace of the transition through its impact on both fertility and mortality. This is especially true of female education. More educated women are healthier and bear fewer and healthier children than women with little or no education. In the previous sections several models have been put forward to explain the factors through which education affects fertility behaviour. The next few paragraphs will summarize recent empirical evidence on fertility differentials by educational attainment, in a regional framework.

Since the 1970s, the commonly held view had been that increasing the education of a population would contribute to fertility decline. This view was consistent with the theory of demographic transition, stating that a steady decline of fertility would take place with increasing levels of socioeconomic development. Cochrane et al. (1979) disproved this notion and found an inverted "U" shape relationship in several developing countries, challenging the common knowledge of a uniform inverse association between fertility and education. With the advent of the World Fertility Surveys (WFS), a largely negative association between education and fertility was confirmed. The strength of this relationship was deemed to be a function of the level of socioeconomic development and cultural factors (Castro Martin 1995).

The influential paper by Castro Martin showed evidence from 26 DHSs surveys and emphasized that "the pattern of association between education and fertility is not static over the course of the demographic transition" and that "considerable diversity existed in the magnitude of the gap between upper and lower educational strata and in the strength of the association across countries"(Castro Martin 1995). Jejeebhoy (1995) analysed education differentials in fertility using a large set of DHS data and concluded that with higher levels of education, fertility declines. Using 57 DHS datasets Bongaarts (Bongaarts 2003) documented empirical education differentials at different phases of the fertility decline and concluded that educational differentials were marginally larger in countries in the earlier stages of the transition and that they were likely to remain when less developed countries reach the end of their transitions.

The findings presented in this section contribute to the debate and inform the assessment of future fertility by education in different projection scenarios. Unlike the case of low fertility countries (see Basten, Sobotka & Zeman, forthcoming), we assess education-specific fertility looking at period-specific fertility rates. Completed fertility has the advantage of overcoming problems caused by tempo distortions since more educated women tend to postpone childbearing, but in dynamically changing societies it is beneficial to capture recent trends. Due to often huge differences between educational attainments of women in fertile ages compared to women with completed fertility, we focus on period fertility rates, as completed fertility may show outdated magnitudes of education differentials in childbearing. Due to increasing education, women with at least secondary education are becoming a less selective group as compared to 20 years ago.

The DHS are a unique source of detailed fertility data for many high fertility countries. We used the two most recent waves of the survey carried out in the late 1990s and 2000s, or the most recent survey only for the countries that did not have more than

one survey after 1995, to reassess fertility differentials by education attainment. We have thoroughly harmonized education to correspond to the definition of six categories used in the global projections (see (Samir et al. forthcoming) for the definition of the categories): no education (no formal schooling), incomplete primary (ISCED 1 not completed), completed primary (ISCED 1), lower secondary (ISCED 2), upper secondary (ISCED 3) and post-secondary (ISCED 4, 5 or 6). Samir et al. (forthcoming) contains a more detailed look at the effort to arrive to comparable education categories. In 26 out of 54 samples for sub-Saharan African countries with very low educational attainments of women and small samples of post-secondary educated women, it was necessary to aggregate upper secondary and postsecondary into a single category.

We have computed education-specific TFRs for 58 countries (94 samples). High fertility countries differ largely in terms of their fertility levels and stage in demographic transitions. Therefore, we focus on relative fertility differentials rather than education-specific TFRs. Relative fertility indexes (RIF), used to analyse fertility differentials by education, are presented by using the group of women with lower-secondary education (ISCED 2) as a reference category.

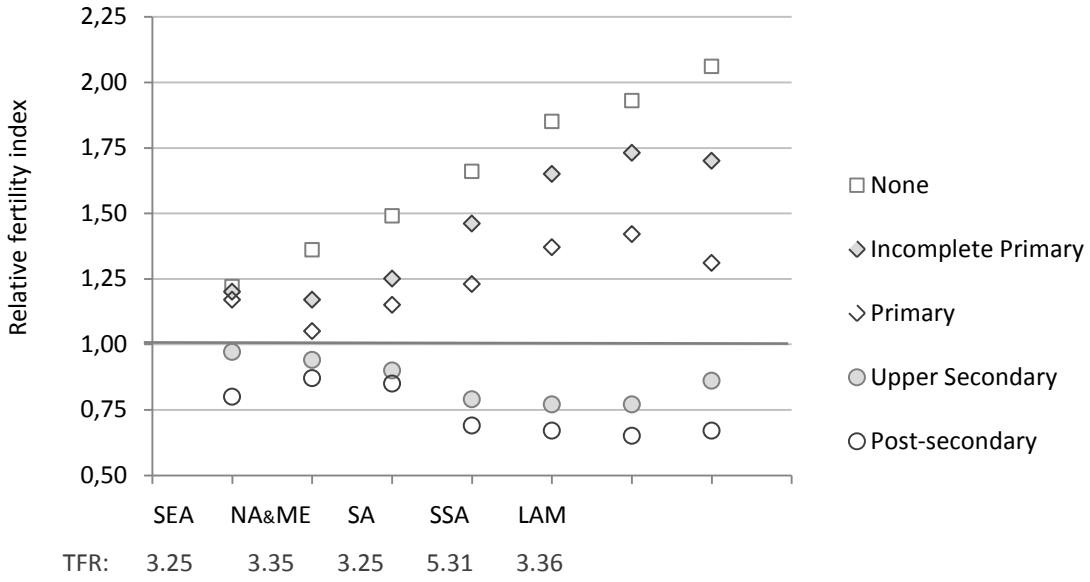

Figure 4. Relative fertility index by levels of education and region

The results shown in Figure 4 highlight considerable heterogeneity across TFR levels and differentials by education categories. However some empirical regularity can be isolated. For instance, we find the usual negative relationship between TFR and female education, without crossovers in the education categories. We find that RFI tend to be more pronounced in countries that are in the middle of the demographic and education transition as best illustrated by Latin America. The differential tends to narrow down only when TFR drops below four children per woman. This pattern is caused by increased education of women and the known depressing effect of higher education on family size. In countries where most women have very little education and only very few achieve post-secondary level, the differential is pronounced, but it is still narrower than in countries where more women have at least completed upper secondary

education (KC & Potančoková 2013). This demonstrates that highly educated women are the trendsetters in preference for smaller families.

3.8 Conclusions

The theoretical and empirical literature on the main drivers shaping future fertility suggests many factors that will potentially play a role in further fertility decline in today's high-fertility countries. While differences are important, all countries and regions will sooner or later pass through the process of demographic transition. How fast they do so, how long they remain in each stage, and whether there will be major disruptions will also depend on unpredictable shocks such as extreme climatic events, political instability, and wars. The expert survey reported in the next section offers country-specific perspectives on future fertility declines. The arguments in this survey include main elements from the literature discussed here. From analysing the experts' predictions about major drivers of fertility decline and their numerical estimates of future fertility levels, we create scenarios for projecting the demographic future of countries from a high-fertility background.

4 Results from the Questionnaire

4.1 Introduction

The High fertility module (HFM) was sent in summer 2011 as part of questionnaires on all demographic determinants to members of IUSSP, PAA, and other professional organizations. The module sought to collect information on numerical estimates of expected fertility transition, as well as to identify the main underlying drivers of fertility transition within a list of potential known factors. The complete list of countries within this categorization as well as countries classified as having high fertility can be found in Basten, Sobotka & Zeman, (forthcoming)

In a first step, respondents were presented for their self-selected country of expertise the baseline fertility estimates for the period from 2005 to 2010, published by the UN (United Nations 2011), and asked to provide estimates for TFR in 2030 and 2050 respectively, as well as an 80 percent confidence interval range. These estimates informed the fertility scenarios, which will be outlined in the next section of this paper. In a second step, respondents were asked to assess the impact and validity of a sample of qualitative statements referring to expected drivers of fertility decline. Finally, respondents were given the opportunity to alter their numerical estimates for 2030 and 2050. The respondents could name other countries for which their numerical and qualitative estimates were also valid and could provide comments on the questionnaire or individual questions.

This section begins with an introduction to the survey design, followed by a description of the survey respondents. We then present and analyse the qualitative statements on expected fertility decline and show the results from the questionnaire. The last part focuses on education-related outcomes from the respondents.

4.2 Survey Design

The high fertility module was embedded in a global survey on the future of fertility, mortality, and migration. A detailed description of the overall questionnaire design can be found in Lutz & Skirbekk (2013). This section provides a short description of the survey structure and indicators used to describe the results.

Each module of the survey consists of a number of *arguments*, clustered in *forces*. These arguments are centred on drivers of fertility decline for the countries in the high fertility module, as identified in the literature review, and are organized within five *forces*:

- Cultural Change
- Health and Child Survival
- Status of Women
- Economic Costs and Benefits
- Reproductive Health

The *arguments*, clustered in *forces* standing for a broader theme, aim to capture the majority of factors/drivers influencing expected fertility transition in the future. The drivers, acting through improvements in reproductive health, child survival, ideational change, and economic factors are formulated in a neutral fashion. In contrast to the low fertility module, the *arguments* mostly point to the direction of declining fertility. Although there are arguably countries where fertility is stalling or increasing slightly, there is broad scientific consensus that demographic transition is underway, even in the highest fertility regions of Africa (see earlier literature review). Within the long-term horizon of our projection period, all countries and sub-regions would enter fertility transition and converge to lower levels of fertility. The formulation of the questions is neutral, e.g., the argument *"More women will decide to stay unmarried"*, does not refer to the consequences for fertility, nor make a value judgment on the outcome of such a development. In total, 30 *arguments* were selected for the high fertility questionnaire and grouped within five forces.

For each *argument*, respondents were asked to gauge its expected future likelihood, or *validity*, and its *impact* pertaining to the year 2050. These are defined and interpreted as follows:

1. *Validity*, ranging from 0 to 1, refers to the likelihood that an argument will be true. Respondents were asked to select from five predefined responses; each response was labeled with an attached validity score. By clicking on one of the responses, the box was visually highlighted. An example is illustrated below:

Module: High fertility countries **Force**: Economic Costs and Benefits **Argument**: The participation of women in the labour force will increase
Based on your knowledge of the empirical evidence and the validity of the reasoning involved, and with reference to the selected country and the period up to 2050, do you think the above argument is:

Very likely to be wrong (0.0)	More wrong than right (0.25)	Ambivalent (0.5)	More right than wrong (0.75)	Very likely to be right (1.0)

2. *Impact*, sometimes also called *conditional impact*, represents the hypothetical influence on fertility if the above stated argument was true. The predefined values ranged from -1 (strong negative effect on fertility) to 1 (strong positive effect on fertility).

Regardless of your answer above, if the above argument were completely true, what effect would this have on future levels of cohort fertility in *country*?				
Strongly decreasing (-1)	Moderately decreasing (0.5)	None (0)	Moderately increasing (0.5)	Strongly increasing (1)

3. In a last step, validity and impact were combined by multiplication to yield the *(mean) net impact.* Even though the likelihood score (*validity*) and *conditional impact* are interesting results as such, the interpretation of the argument might change dramatically when merging the indicators. Depending on the framing of the question and the country considered, an argument could "very likely be right", but at the same time have no expected effect on fertility. The resulting value was presented to the respondents and they were allowed to alter the value by repositioning the slider on a bar ranging from -1 to 1. About ten percent of respondents altered their initial judgments.[8]

Based on your answers, we have calculated the overall net impact on future cohort fertility on a range from1 to +1 (resulting from a multiplication of the weights in parentheses, hence this is not in units of cohort fertility, but a standardized weight of impact relative to other arguments). You may adjust this overall impact if you wish.

All indicators (mean likelihood, mean conditional impact, and mean net impact) were calculated for each argument, as well as for selected regions and countries. All summary measures were calculated as simple means, without applying population weights. Given the unequal distribution of population sizes across our set of high fertility numbers, responses for a small number of countries would have disproportionately dominated the overall results.

Aggregate arguments scores represent the sum of net impacts for all 30 arguments by each respondent. The *combined net impact* summarizes the net impact across selected arguments, countries or regions. Again, the values are combined by summation and created for separate arguments, forces or regions Numerical estimates for 2030 and 2050 were calculated using population weights within each region.

[8] A number of respondents reported that they had difficulties moving the slider on the horizontal bar. Other respondents misunderstood the handling and meaning of the slider and set the values all to 0. For these reasons the adjusted net impact was replaced by the calculated values (validity times conditional impact) if values were missing or faulty.

The next sections present the results from the experts' assessment. We start with a description of the respondent's background characteristics, then proceed with results from their qualitative statements. Finally, numerical expectations for 2030 and 2050 will be presented across regions and selected countries. A full description of the arguments as well as the numerical estimates can be found in the appendix of this paper.

4.3 Demographic Characteristics of Experts[9]

Altogether, 140 experts completed the high-fertility questionnaire that was sent to members of professional organizations in 2011. Most experts provided an assessment for one high fertility country, while two experts answered for two countries. The respondents were allowed to provide information that could be compiled into a demographic profile. The typical respondent was male, 42 years old and working in academia. Sixty-nine percent were male, and 31 percent were female. Most experts were employed in academia (56 percent), 11 percent worked in international NGOs (Population Reference Bureau, APHRC, Futures Group, Population Council, etc.), and the remaining 33 percent were distributed equally between national NGOs, governments, and think tanks. There were three experts below the age of 25, with a majority (22.6 percent) aged 35 to 45. The oldest expert was 76 years old at the time of the survey.

4.3.1 Countries of Analysis

Most experts filled out the questionnaire for South Central Asian countries (Figure 5). Indi , with 37 experts, leads the ranking of countries analysed. While there are only 28 experts from India, nine experts originating from outside India (mostly from the United States) filled out the questionnaire on India. Twelve more experts filled the questionnaire on Nepal, 12 on Bangladesh and Pakistan, and one each on Afghanistan, Bhutan, the Maldives and Sri Lanka. Southeast Asia is quite well covered with 14 experts on Indonesia, Malaysia, the Philippines and Vietnam.

[9] About 15 percent of respondents did not supply their demographic characteristics. The percentages presented here are based on the total of all available information within each subcategory.

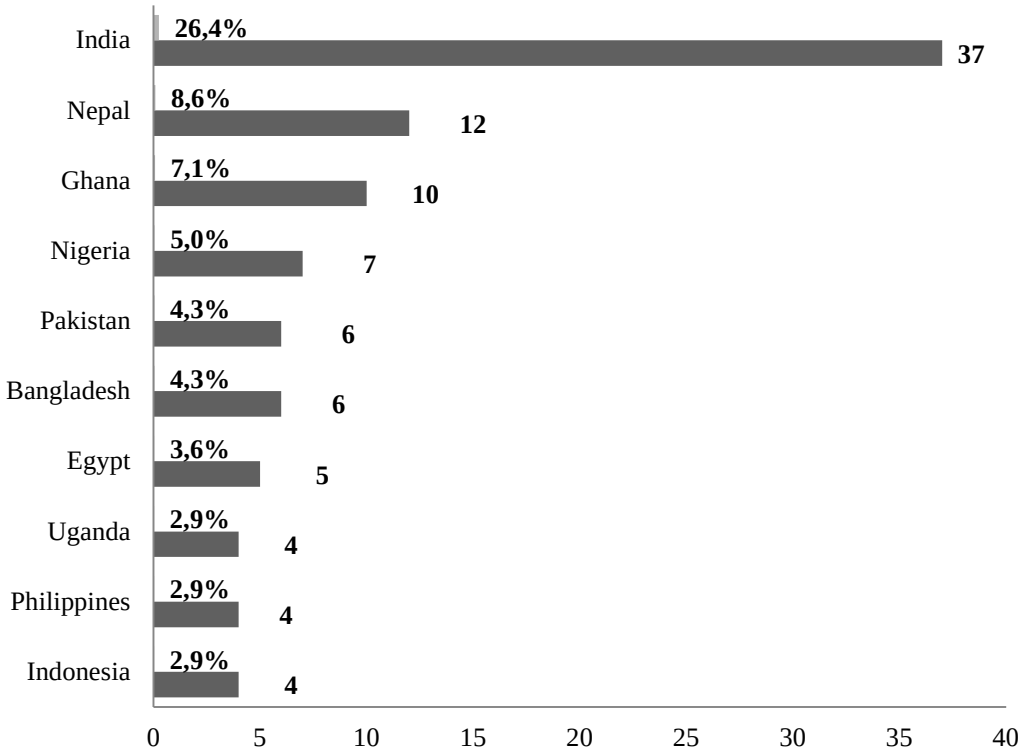

Figure 5. Number (and share) of experts for the top countries of analysis

In Africa, we received 16 expert judgments for eight distinct countries in Eastern Africa: Ethiopia, Kenya, Malawi, Mozambique, Rwanda, Tanzania, Uganda, and Zambia. Most respondents on Western Africa are experts on Ghana (12) and Nigeria (7), and fewer responded for Burkina Faso, Mali, Niger, and Senegal. Out of seven experts on Northern Africa, five are on Egypt, and one each on Sudan and Morocco. The coverage on Southern Africa (4) is poor, with only two experts completing the questionnaire on South Africa, one on Lesotho and one on Botswana.

The Latin American and Caribbean region where few countries with a high fertility remain is underrepresented, as only eight experts filled the questionnaire: Haiti (1), Panama (1), Bolivia (1), Ecuador (1), Peru (1), Suriname (2) and Venezuela (2). Similarly, there was only one expert for Oceania, on Papua New Guinea. These regions are not represented by a large enough number of experts to derive statistically reliable conclusions.

4.4 Forces

Before analysing the results in more detail, Table 1 summarizes the main findings across forces. “Mean weight” describes the weight of each force relative to the other forces. The sum of mean weights across clusters is 1. Even though the experts evaluated the force, “Economic cost and benefit” as the most powerful driver for shaping future fertility (0.24), the overall difference in term of weight between the different forces is small, with the “health and child survival” and “Reproductive Health” forces scoring lowest, relative to the other forces (0.17). All forces seemed of equal importance to the experts, even when investigating regions separately.

Table 1. Main findings across forces

force	mean weight of force	likelihood score	conditional impact on fertility	net impact on fertility
1. Cultural change in ideal family size (CULTURAL)	0.19	0.64	-0.35	-0.22
2. Health and child survival (HEALTH)	0.17	0.80	-0.39	-0.28
3. Status of women in family and society (STATUS)	0.22	0.78	-0.47	-0.32
4. Economic cost and benefit (COST)	0.24	0.76	-0.41	-0.28
5. Reproductive Health (RP HEALTH)	0.17	0.57	-0.30	-0.22

Averaging the expert likelihood scores across countries, the resulting mean likelihood score is presented here. It can be interpreted as the predicted "degree of truth", or how likely it is that the suggested statement will come true. For high fertility countries, the experts valued arguments in the second force, "Health and child survival", as most likely to come true, whereas this force was evaluated lowest in the relative importance across clusters. Experts believing in improvements in health and child survival (most arguments were formulated positively), regardless of rapidly decreasing fertility, would be an extreme interpretation of the phenomenon. The lowest likelihood score was attributed to the "reproductive health" force, which results as well in the lowest "conditional impact on fertility".

On the contrary, the "conditional impact on fertility" is highest for the force related to the "Status of women in family and society". Thus, experts expect changes in female status to have potentially the strongest depressing effects on fertility. Multiplying the "likelihood score" with the "conditional impact" on fertility yields the "net impact on fertility". Hence, by generating the product of the likelihood of an event with its impact, we derive a combined measure of expected changes in fertility, weighted by its expected chances to come true. The "net impact" on fertility shows that the status of women is thought to have the largest depressing effect on fertility.

Overall the different scores calculated for the forces reinforce the first impression that the experts tend to think that no one force could be responsible for a decline in fertility, but rather a balanced mixture of all forces, with one force emerging occasionally as slightly more important, but not substantially so. That is why it is interesting to identify a general trend in the expert's evaluations and more informative to investigate individual argument scores rather than summary measures across forces. Single arguments within forces could drive average net impact scores up or down, even if the other arguments show strong overall effects. This is discussed in the next section.

4.5 Analysis of Likelihood Scores

Table 2 displays the arguments resulting in the highest and lowest likelihood scores, independent of the expected net impact on fertility shown in Figure 6. For the experts, these statements are very likely to come true (or most likely to be wrong), regardless of their effect on fertility. Most arguments were phrased positively, meaning that the general indicators of development, health, supply of contraceptives, etc. would improve. As a consequence, there are few arguments with low likelihood scores.

The experts seem to agree with the theory developed in part B about the main drivers of fertility decline in developing countries: female education, urbanization, and the costs of raising children. The experts assigned the highest likelihood to the argument, "Female educational enrolment rates will increase". A second argument, connected to the force on female status in family and society, "The age at first marriage will continue to increase", is among the top five arguments most likely to be right. Also top ranked are two arguments relating to economic cost and benefit. These arguments state that the cost of raising children in urban settings will increase, and parents put increasing value on good education of their children. There is a strong belief among experts that education not only plays a major role in further developments, but also that governments will be committed to further invest and improve educational systems.

Table 2. Details about the five arguments most likely to be right and most likely to be wrong

force	argument	likelihood score	conditional impact on fertility	net impact on fertility	mean weight of force
Most likely to be right					
Status	Female educational enrolment rates will increase	0.91	-0.58	-0.45	0.22
Cost	The cost of raising children in urban settings will increase	0.88	-0.55	-0.41	0.24
Cost	Parents put increasing value on good education of their children	0.88	-0.52	-0.38	0.24
Status	The age at first marriage will continue to increase	0.87	-0.55	-0.40	0.22
Health	Parents will expect that most of their children survive to adulthood	0.86	-0.38	-0.29	0.17
Most likely to be wrong					
Status	More women will decide to stay unmarried	0.56	-0.36	-0.19	0.22
Cultural	Childlessness will become socially acceptable	0.52	-0.35	-0.15	0.19
RP Health	Traditional methods of family planning will remain/become widespread	0.42	-0.13	-0.09	0.17
Cultural	Religions and religious beliefs will become more important for fertility decisions	0.34	0.02	-0.01	0.19
RP Health	Modern contraception will be banned for religious, political or other reasons	0.14	0.18	-0.01	0.17

Further arguments with high likelihood scores are linked to health, including birth spacing, decreasing infant mortality and improved access to sanitation and health care. There is little disagreement on the positive development of health related factors. With regard to reproductive health, experts are convinced that the availability of modern family planning services will significantly increase and do not foresee a ban of modern contraception for religious, political or other reasons.

There is some disagreement relating to cultural factors. Most experts have positive expectations for the further adoption of modern contraceptives and increased autonomy of couples in fertility decisions. Also, relatively few experts believe that religions and religious beliefs will become more important for those making fertility decisions (0.34). Nonetheless, the disagreement with the statement is not as strong as for

banning modern contraceptives. The value lies between “more likely to be wrong than right” and “ambivalent”.

4.6 Analysis of Net Impact Scores

The next sections of this paper show global results as well as results for sub-Saharan Africa and South-Central Asia. The majority of respondents (114) picked a country within these regions. Thus, due to low number of respondents, we do not specifically refer to countries outside of these two regions. Figure 6 displays the net impact scores of all arguments across forces for all countries. Results for South-Central Asia and sub-Saharan Africa are labeled with markers.

As discussed earlier, since fertility is expected to decline, most phrases were framed positively, such that net impact scores for all arguments across all countries were negative, implying fertility decline. The experts expect effects to be larger for countries in sub-Saharan Africa than for regions in south-central Asia, because starting values of fertility are higher in Africa. In fact, as shown in Figure 6, almost all net impact scores were larger in sub-Saharan Africa than in South-Central Asia. However, in four of the 30 arguments in the questionnaire, the expected net impact on fertility was larger in the Asian than in the African sub-region. The argument on ‘son preference’ is particularly interesting: although the effects were expected to have a significant impact on fertility decline in both regions, the effect in South Central Asia was particularly large, relative to the other arguments. In contrast, the argument was not ranked very highly in comparison with the other arguments in sub-Saharan Africa.

Not surprisingly and consistent with the high likelihood shown in the previous section, Figure 6 shows that three out of five arguments with strongest depressing impact on fertility belong to the third force, related to the status and autonomy of women. Increasing female educational enrolment is ranked first (HF3-2), and increasing age at first marriage (HF3-4) and the participation of women in the labour force (HF3-5) are ranked fourth and fifth. Arguments related to women’s status with the lowest net impact on fertility are arranged marriage (HF3-1) and an increasing share of unmarried women (HF3-6). Bearing in mind that arranged marriage is still an important factor in nuptiality, especially in South Asia, other forces are considered more important for immediate changes in fertility behaviour.

Furthermore, the arguments on the cost of raising children in urban settings (HF4-4) belong to the set of most important drivers of fertility decline. Urbanization as driver of fertility decline is at the root of modern demographic transition theory, and the experts identify it as a driving factor for fertility transition in our high fertility sub-sample. The arguments relating to female employment (HF4-3) and the closing gender gap in educational enrolment (HF4-5) were also assigned high net impact scores. As mentioned earlier, the belief in establishing public pension funds and social security systems is weak (HF4-1). The experts do not expect large impacts of decreasing prevalence of child labour on fertility behaviour.

Almost uniformly, experts worldwide think that improving access to family planning services (HF5-1) is one of the most important drivers of fertility decline. Rather than switching from modern means of contraception to traditional methods to

escape potential side effects, the experts expect the development and distribution of modern contraceptives without side effects.

The experts are strongly convinced that individualism will gain momentum and thus decisions about family size will increasingly be made by couples themselves, with less pressure from members of the extended family or the community (HF1-1). The argument with the largest expected impact on fertility, however, refers to diminishing negative attitudes towards contraception (HF1-5). Given current high educational differentials in desired family size, argument HF1-7 relates to a decreasing educational gradient as demographic transition progresses. The experts rank this argument third in its expected likelihood and net impact on fertility across all arguments on changing family size ideals

The resulting sores from the HEALTH cluster are relatively homogenous. While the experts assign the smallest likelihood to a lower percentage of teenage pregnancies (HF2-1), the lowest net impact on fertility is expected to result from improved access to health care and sanitation for mothers and their children (HF2-2). The highest net impact on fertility is expected to arise from increasing birth intervals (HF2-4).

The two least important factors for fertility decline are, as already identified in the likelihood ratings, religions and religious beliefs for fertility decisions (HF1-2), and banning modern contraception for religious or other reasons (HF5-5). Even though the experts assign a positive conditional impact to these arguments, the overall net impact is negligible.

Two arguments related to economic cost and benefits are ranked among the arguments with the weakest impact on shaping future fertility. They are declining prevalence of child labour (HF4-6), and pension funds and social security systems replacing family support in old age (HF4-1). Neither of those factors is expected to have significant impact on fertility. The experts assign low likelihoods, as well as low conditional impacts, to both arguments. This result is remarkable, for while the experts strongly believe in further improvements of educational systems, female autonomy and improving supply and acceptance of modern contraceptives, there is little belief in changing policies against child labour or policies establishing social security systems. Even if there was a significant likelihood of changing systems, the experts assign relatively low impact on fertility to the arguments.

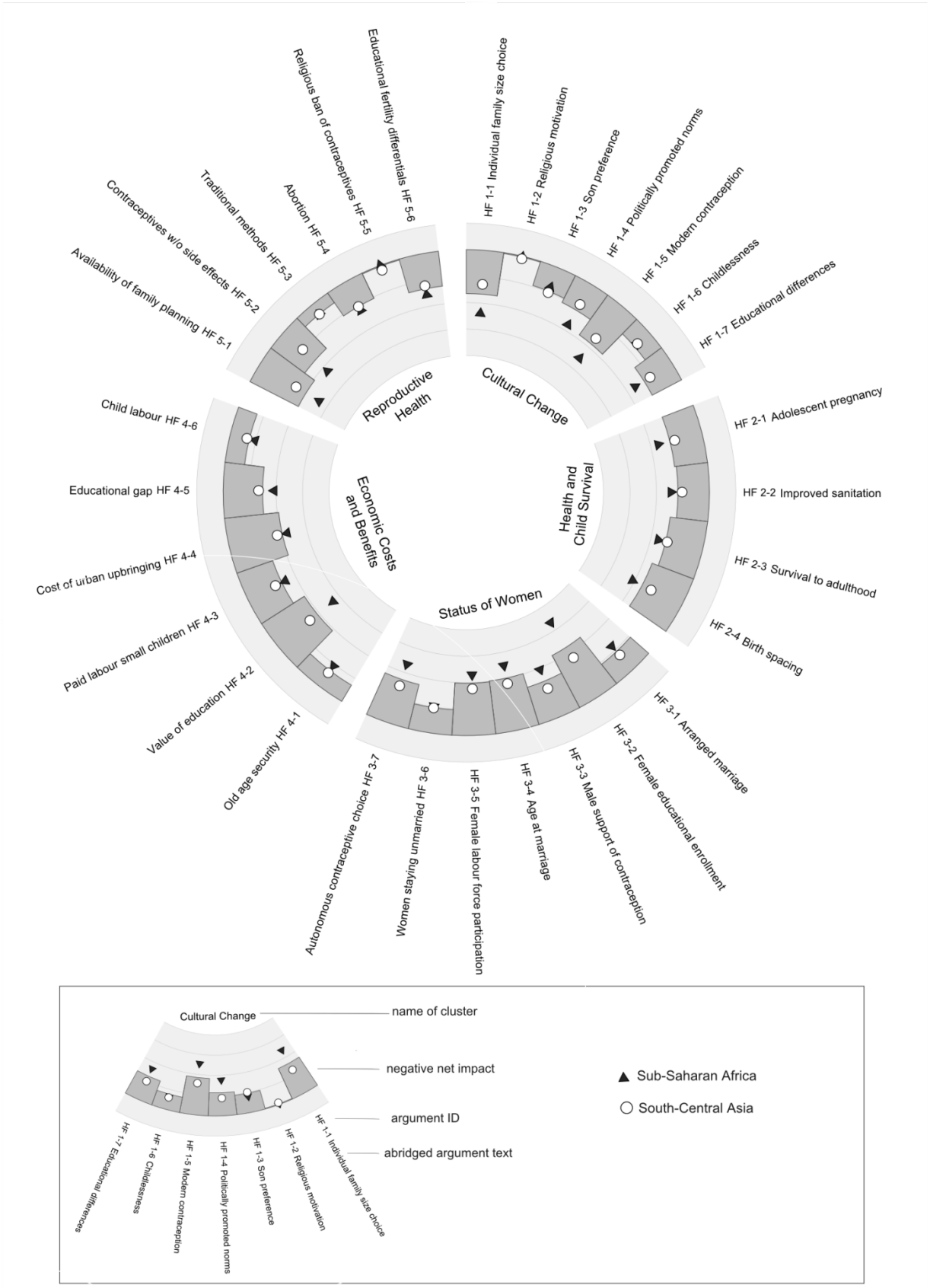

Figure 6. Net impact scores for all arguments by cluster

4.7 Regional Differences

Given the current high levels of fertility, compared to most countries outside of these two regions, the countries find themselves at very different stages of demographic transition. As a result, expected fertility declines might be caused by distinct mechanisms that vary regionally. Tables 3 and 4 list the arguments with highest net impact on fertility in and outside sub-Saharan Africa. The average level of net impact scores is lowest in sub-Saharan Africa. Assuming a negative relationship between net impact scores and the expected fertility decline in Africa, the experts thus predict larger decreases of fertility in sub-Saharan Africa than in the other high fertility countries by 2050. This is consistent with demographic transition theory, which holds that higher rates of decrease are expected at earlier stages of fertility transition than in later phases.

In sub-Saharan Africa, two out of three highest ranked arguments concern education. Experts are confident about subsequent improvements in female enrolment and parents' educational investment in their offspring. These measures are expected to have strong impacts on future fertility. The argument on increasing availability of modern contraception also shows up consistently atop rankings by country or region. The experts have strong beliefs in future investments and government commitment in satisfying the unmet need for family planning. Easing the access and improving the supply of modern contraception tops the agenda of many development agencies (see e.g. Gates foundation).

Interestingly, the experts assigned the argument on increasing costs of raising children in urban settings the largest net impact score. Further increasing rates of urbanization in many Asian countries (i.e. Bangladesh, India) put pressure on governments with regards to urban planning, with rapidly growing mega-cities leading to housing shortages and growing urban slums. It can be argued that sub-Saharan African countries are not yet at this stage of development. While Africa is also experiencing rapid rates of urbanization, industrialization and educational systems are far more developed in Asia and certainly Latin America countries.

Outside of sub-Saharan countries, the experts assign the second largest weight to the depressing effect of increasing female labour participation on fertility. It has been shown that women employed in poorly paid agricultural work are often able to bring along their children, and that the positive income effect of female employment outweighs the negative effect of higher opportunity costs. In contrast, for women in the industrial sector, rising opportunity costs dominate the income effect, and increasing proportions of women in the labour force have depressing effects on aggregate fertility.

However, even with differences in the ranking of arguments across countries and regions, there is a high degree of homogeneity in the experts' judgment of relevant determinants of future fertility. The magnitude of expected future changes in fertility vary by the level of current fertility, with experts predicting larger negative effects on fertility for still very high fertility countries, and smaller decreases for countries in the middle of demographic transition. Apart from the several questions on the impact of religious beliefs on family size norms and banning modern contraception, all arguments were considered more or less relevant for shaping future fertility. The experts, almost

uniformly, believe in the path suggested by demographic transition theory. Accordingly, there is no reason to assume on this basis that sub-Saharan Africa will enter or remain in a phase of stalling fertility. Expected improvements in health, female autonomy, norms and values, and their impact on fertility were largest in this region.

Table 3. Three arguments with highest net impact on fertility in sub-Saharan Africa

force	argument	net impact on fertility	likelihood score	conditional impact on fertility
Status	Female educational enrolment rates will increase	**-0.65**	0.92	-0.74
Cost	Parents put increasing value on good education of their children	**-0.53**	0.88	-0.63
RP Health	The availability of modern family planning services will significantly increase	**-0.52**	0.82	-0.67

Table 4. Three arguments with highest impact on fertility outside of sub-Saharan Africa

force	argument	net impact on fertility	likelihood score	conditional impact on fertility
Cost	The cost of raising children in urban settings will increase	**-0.40**	0.90	-0.54
Status	The participation of women in the labour force will increase	**-0.37**	0.86	-0.51
RP Health	The availability of modern family planning services will significantly increase	**-0.37**	0.82	-0.53

4.8 Numerical Estimates[10]

This section assesses the numerical estimates of fertility levels predicted by the experts. Given the current level of fertility, the experts were asked to provide a prediction for 2030 and 2050 for their country of choice. Figure 7 shows population-weighted numerical predictions of the total fertility rate in 2030 and 2050 for all experts. Data for 2010 represent UN 2010 period estimates for 2005-2010.

Across all countries in the expert sample in sub-Saharan Africa, experts predict average fertility to decline to 5.2 in 2005-2010 to 3.8 in 2030. By 2050 they expect the total fertility rate to reach a value of 3.2.

Due to the high population weight of India, the numerical predictions in South-Central Asia are biased towards the Indian experts. By 2050, fertility is expected to fall from a total fertility rate of 2.9, by almost one child, to 2.0. While we observe a large range of fertility outcomes (Afghanistan 2005-2010: 6.3; Maldives 2005-2010: 1.8) in

[10] The following section exclusively deals with *point* estimates derived from the high fertility questionnaires. Minima and maxima were discarded because of technical problems reported by respondents using Internet Explorer

the base year, all experts expect fertility to drop significantly, including in today's highest fertility countries (Afghanistan 2030: 4; 2050: 1.9).

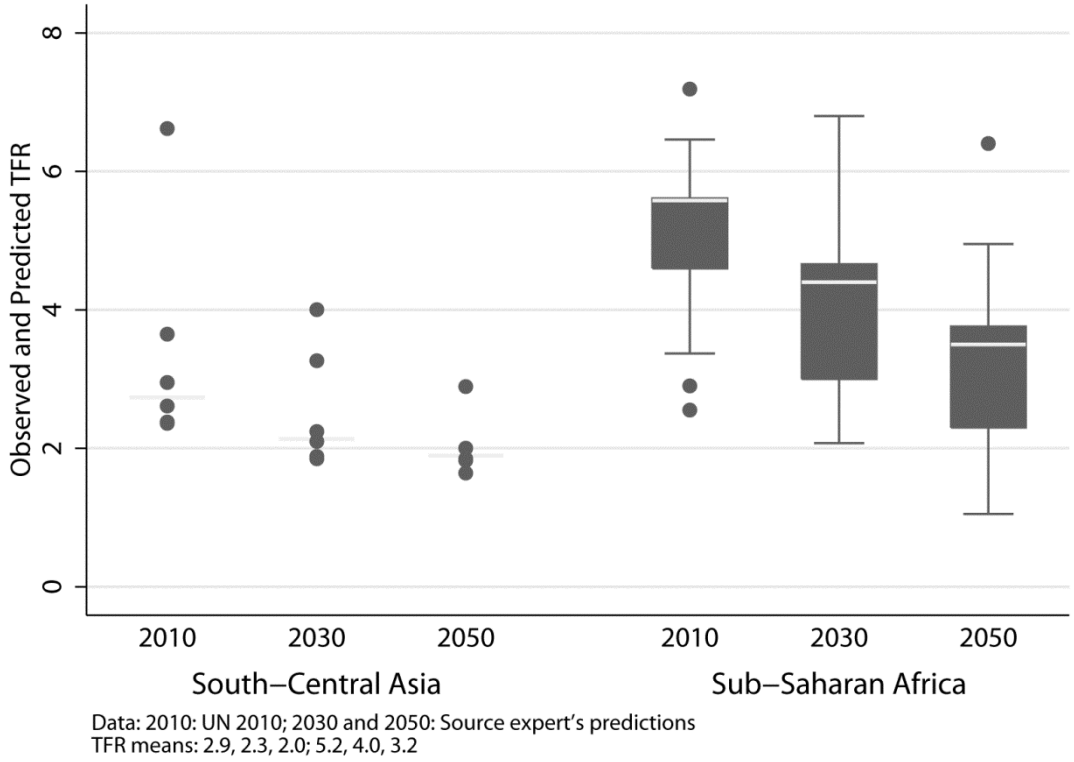

Figure 7. Population weighted numerical predictions of total fertility rate in 2030 and 2050 for all experts and 2010 estimated TFR, South-Central Asia and sub-Saharan Africa

India is by far the most populous country in the sub-sample of high fertility countries. Its development is crucial to world population growth. After dropping unreasonable responses[11] from the numerical estimates, 30 experts remain from India. The mean value of TFR predicted for 2030 and 2050 is 2.1 and 1.9, respectively. However, Figure 8a shows that the experts' opinions on India's future are quite widely distributed. The values for 2030 range from 1.5 to 2.5 in 2030, and 1.05 to 2.45 in 2050.

While Ghana cannot be compared to India in its contribution to world population growth, it is the country with the largest number of expert predictions in sub-Saharan Africa (n=10 after cleaning). Experts for Ghana provide a wide range of estimates, with the minimum and maximum estimates varying importantly (see 4.8b). The numerical estimates from India and Ghana underline the necessity of having large enough expert samples for using expert predictions in the assumption-making process. Country-specific predictions originating from a small number of source experts should be evaluated with a higher degree of uncertainty when making fertility scenarios, compared to countries with many experts.

[11] See footnote 9.

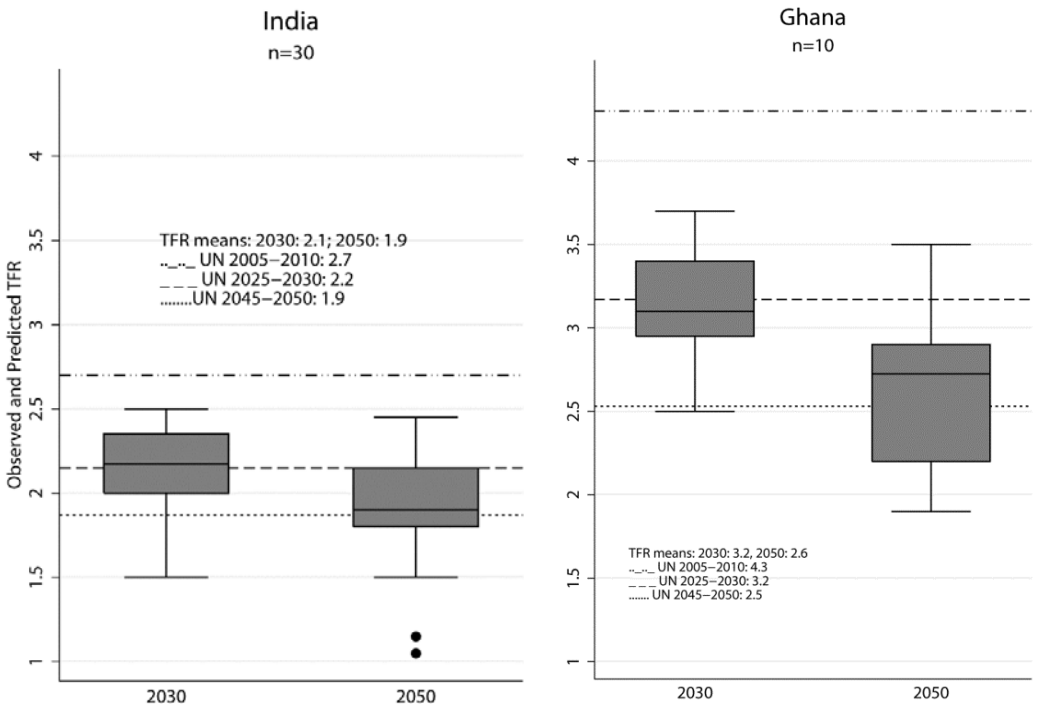

Figure 8a, b. Numerical estimates by experts for 2030 and 2050, Ghana and India

Even though we only show a selected sub-set of numerical predictions, the general tendency is clear: there is little to no disagreement about the downward trend of fertility. With few exceptions, the experts predict fertility to decline, to a higher degree in yet very high fertility regions (sub-Saharan Africa), and to a smaller degree in regions that are further along in the process of demographic transition (Latin America). The experts, on average, follow the stereotypical descent of a country in fertility transition. While there are more pessimistic experts for several countries in sub-Saharan Africa (see Burkina Faso, Mozambique, Niger) than for others (see Ethiopia, Ghana, Senegal), the number of experts predicting relatively slow/fast fertility decline is too small to automatically assume slow descents for a given country or region.

5 High Fertility Assumptions

5.1 Introduction

Policy makers, NGOs and the informed public make frequent use of future population scenarios produced by demographers. Conventional methods of projecting future trajectories are based upon the judgments of few experts, sometimes supported by time-series, logistic regressions and other models. The IIASA/Oxford science-based World Population Projections are an attempt to overcome limitations of standard assumption making by soliciting the views of a large number of experts and then having a group of meta-expert reflect on the questionnaire results, and combining those expert opinions with a theoretical model, as well as data on country-specific historical fertility declines. This section discusses the assumption-making process for countries in today's high fertility world.

5.2 Results from the Meta-expert Meeting

The meta-expert meeting on high fertility took place in Dhulikhel, Nepal, from November 7-9, 2011[12]. After considering results of the expert questionnaire, the meta-experts held a general discussion to identify the most important drivers of fertility. They designed high and low fertility storylines for three major regions (Africa, Asia, the Middle East and North Africa, see box 4). Assuming a pessimistic or optimistic level of development, these storylines picture potential fertility outcomes in the respective regions. After creating the storylines, the experts discussed country-specific fertility futures.

5.2.1 Main Drivers of Fertility and Country Specific Meta-expertise

While the expansion of education could be the main driver of fertility decline in many countries (as seen in Singapore and South Korea) and a necessary condition for changing fertility norms and behaviours, the experts argued that it might not be sufficient under certain fertility regimes and given other socioeconomic conditions. While many sub-Saharan countries have promoted education, especially educating girls and women (Ethiopia, Ghana), variation in the quality of education remains large. Furthermore, it has been shown that education does not necessarily (as in Nigeria) lead to upward mobility. Despite ambitious education policies in such countries as Kenya, economic development is lagging lags behind, resulting in high levels of unemployment. In Egypt, despite increasing education of younger cohorts, unemployment is high and the share of women participating in the labour force remains low. In India, education-specific fertility rates declined uniformly in the past; however, more recently, the most rapid decline has been occurring among the low educated, whose fertility is converging to the level of their highly educated counterparts. Pakistan is following the trend in India, with further declines in fertility expected as Pakistan continues its substantial increase in education investments. In South-Asia, despite a declining quality of education and decelerating economic growth in the Philippines, overall labour force participation by women is relatively high, compared to women in India or Pakistan. As a result, it is likely that fertility will further decrease in Indonesia and the Philippines. Similarly to Egypt or Kenya, economic progress is not proceeding at the same pace as improvements in education, and labour markets cannot fully absorb young, well-educated cohorts. Nonetheless, fertility ideals seem to continue decreasing, in spite of, or even because of economic uncertainty.

Political commitment is a crucial factor in demographic transition and fertility decline (for example, contraceptive prevalence and program efforts in Bangladesh). Such commitment will be a key element, especially in sub-Saharan Africa where accelerated fertility decline could be foreseen, if governments and international organizations commit more resources to family planning programs. In the case of

[12] Experts attending the meeting were: Mohammad-Jalal Abbasi-Shavazi (Australian National University), Youssef Courbage (Institute National d'Etudes Démographiques), K.S. James (Institute for Social and Economic Change, Bangalore), Gavin Jones (Asia Research Institute, National University of Singapore), John F. May (World Bank), Vinod Mishra (United Nations Population Division), and Bruno Schoumaker (Université Catholique de Louvain). The meeting was moderated by five researchers from the Wittgenstein Centre: Bill Butz, Regina Fuchs, Anne Goujon, Samir KC, and Wolfgang Lutz.

Rwanda, Niger, Ethiopia, and Madagascar, contraceptive prevalence rates have increased recently as a consequence of political efforts. In contrast, in the Western African countries of Nigeria, Niger, Senegal, Chad, and Mali, political commitment to family planning is weak and, as a result, contraceptive prevalence and infant/child mortality are high. In the high-fertility regions of Nigeria, contraceptive prevalence rates are extremely low and only increasing very slowly. The same is true of other indicators such as infant and child mortality rates, which suggests that fertility is not going to experience a major decline in the foreseeable future, given the lack of support from governments in the region for family planning and/or socioeconomic development. While important steps were made to bring down infant and child morality in Niger, the recurrence of a food crisis could counter the current efforts to reduce IMR and CMR.

Ghana serves as a positive role-model for West Africa, having experienced income growth and fertility decline in the last decade. Its fertility rate is expected to decline more rapidly than in most other countries in the region. However, the fertility decline and related family planning efforts in Ghana have relied to a certain extent on abortion more than adoption of contraception. In Ghana, as well as in many other African countries, patterns of contraceptive use are disconnected from fertility behaviour, since large proportions of men are living abroad and women are therefore not exposed to pregnancy.

Political commitment in East Africa is framed by opposites. In Ethiopia there is serious commitment to family planning and many volunteers promoting contraception across the country. The reverse is true in Uganda, where the current leadership is pushing pro-natalist policies that experts expect will slow the fertility decline that has been underway. The situation in Egypt is ambiguous, with pro-natalist attitudes prevalent among the population and the authorities. The importance of the Muslim Brotherhood could impede progress in fertility decline since the organization is one of the providers of social services and encourages early marriage and large families

Many states of India, including the most fertile (Uttar Pradesh, Bihar, and Punjab), have low fertility in urban areas (1.3 children in Calcutta) and show strong declines that point to further declines in many states where fertility is still high. Although political commitment to family planning is strong, norms and marriage patterns change slowly, and it is unlikely that fertility will fall below 2.0 children in India in the near future. Even in Bangladesh where family planning programs are very strong, there are still large pockets of high fertility in slums and in some remote places with few services. Other indicators, such as age at first marriage (very low) and abortion rates (very high), could also have an inhibiting impact on further rapid fertility decline. Thus, uncertainty is larger in India because the country could either go down the East Asian road of rapid fertility decline or else pursue a different path. Publicity for family planning has been very active and successful in Nepal, similar to programs carried out in Bangladesh. However, improvements in reproductive health are lagging behind the family planning efforts as shown by infant and child mortality indicators. Also, the single mean age at marriage is still very low (about 18 years). In nearby Pakistan, levels of education and contraceptive prevalence are low and unlike in Nepal, there is little support for family planning.

In Indonesia, signs seem to point to a decline in fertility rather than a further stall or increase. Increasing postponement of fertility, decreasing rates of breastfeeding,

increasing divorce rates and a rising share of the better educated are underway. Nonetheless, religiosity is high and people have conservative views about family, contrasting with high labour force participation by women. Hence, there are reasons to believe that Indonesia will follow the Indian example of fertility decline. In the Philippines there is strong political will to bring fertility down, and the traditional impact of religiosity on fertility is weakening. Still, there are considerably high rates of unmet needs in the women's health field, and the supply of contraceptives is unsatisfactory. Given the political commitment in the Philippines, however, fertility is likely to decrease even further.

The importance of politically motivated fertility, especially in the Middle East, should not be underestimated, as shown in Syria, Palestine, Israel, and potentially in Egypt, Algeria, and Tunisia. Rather than stopping fertility decline, so-called "war-fertility" is most likely to slow down the fertility decline. For example, the main obstacles to a fast decline in Nigeria are related to a widespread practice of regional fertility behaviours that are connected to ethnic and religious differences that maintain high fertility. Also, Yemen is divided politically, regionally, and ethnically and is one of the few countries where consanguinity (or kinship) increased across generations. The commitment to progress toward lowering fertility seems very low at the societal and governmental level.

Outmigration of an active labour force is an important factor in the Philippines, as there are large migration streams to Western Asia and Europe. In Nepal, internal and international migration plays a role in fertility and should be kept in mind in any analysis of fertility rates. The dominant trait of demographic change in recent years had been streams of people moving out of the hills and mountains to live in the valleys and plains. For those migrating out of Nepal, the movement has been predominantly to the Gulf states and India. Remittances are very high and account for a quarter of the GDP. Urbanization rates have been steadily increasing (currently above 55 percent) and urban fertility is very low, with a TFR of 1.6. The situation is comparable to Ethiopia, where population pressure on the highlands pushes urbanization and constrains fertility. In Ethiopia's urban settings, fertility is already below replacement level. The pressures from a growing population can also be observed in Egypt, where the country faces acute shortages of both land and water. However, Egypt has managed to increase arable land in the desert along the Nile River. Despite the trends in Egypt, however, the role of population pressures should not be overestimated in their importance for fertility decline. Countries like Java, Bangladesh, and North Vietnam face population pressures similar to Egypt, yet have been successful at reducing fertility rates.

Having identified education, overall political commitment, and politically motivated fertility programs as key forces in further fertility decline, researchers must also consider other norms, values, and events when analysing fertility. Among these are ethnic diversity, kinship systems, globalization, national and international conflicts, population pressure, poverty, economic development and investments in health. While demographic transition follows similar patterns across world regions, most countries in Asia find themselves at levels of fertility very different from the majority of countries in sub-Saharan Africa. With few exceptions, demographic transition in South Asia is well ahead of economic development in sub-Saharan Africa, especially West Africa. Kinship systems, strong preferences for large families, HIV/Aids, weak governments and ethnic conflicts are some of the factors that explain differences in fertility and the speed of

fertility decline within and across these two regions. The following paragraphs sketch potential demographic futures with low and high fertility, respectively, for Asia, the Middle East, North Africa, and sub-Saharan Africa.

Box 4: Story Lines for World Regions by Meta-experts

Asia

High Fertility Storyline: Cultural/familial/gender norms remain unchanged, with the norm of low age at marriage persisting and divorce and remarriage remaining largely unacceptable. The desired number of children remains high, and access to family planning information and services remain stagnant. Pro-natalist religious/ethnic ideologies persist. Religious and political leaders play an essential role in preserving traditional societal regimes. Female education and labour force participation stagnate, as well as improvements in health care and child survival.

Low Fertility Storyline: The region witnesses rapid changes in cultural, familial, and gender norms. Values are in place that include marriage choice, individualism, and gender empowerment. Provision of safe, effective, affordable, and acceptable methods of family planning becomes universal. Secularization and decline in religiosity weakens pro-natalist attitudes and reduces the influence of religious and political leaders. Universal secondary education for females and rapid increase in opportunities for gainful employment empowers women to participate fully in the economy. Health care expands rapidly and child survival increases significantly.

Middle East and North Africa

High Fertility Storyline: The increasing influence of cultural and political minorities slows the process of fertility decline. This trend is exacerbated by religious-political agendas, explicit or hidden. Slowing international migration to the Western world and/or increasing migration to more conservative settings slow the pace of fertility decline. Oil-based economies reduce the individual costs of having children and thus maintain higher levels of fertility.

Low Fertility Storyline: Increasing educational levels, particularly for women, combined with increasing urbanization, raises the status of women, the cost of children, and the desirability and necessity of having jobs prior to marriage and childbearing. Simultaneous globalization leads to ideational change, including smaller family size. International migration to modern countries accelerates this process.

Africa

High Fertility Storyline: Progress in education is slow and there is little spill over from high to low socio-economic strata. There is no progress in gender inequity. Weak governance and social conflicts result in slow health improvements and little progress in delivery and access to family planning services. Governments don't commit to fertility reduction. Inevitable globalization and the negative consequences of population growth mean there is less available land. The result is the slow onset of fertility decline in most of the densely populated areas.

Low Fertility Storyline: Strong political efforts raise education and increase social mobility. The impact of education increases and leads to further fertility reduction.

continued on next page

Sex education becomes part of the school curriculum and adolescent pregnancies become rare. Women become increasingly autonomous. Governments are fully committed to reducing family size, and the countries witness rapid improvements in the provision of health and family planning services. Awareness is raised through media campaigns advocating for small families, as well as public debates, and advertisements for condoms and contraceptive use. The secondary effects of AIDS campaigns that urge condom use and "safe sex" thinking, lead to an increasing use of contraceptives. Strong interaction with the more developed world, including international migration, reinforces and spreads ideational change.

5.3 Fertility Scenarios: Data and Methods

Our assumption-making process consists of a three-stage modeling approach. First, we estimate a model using a country's level and decrease of fertility during the last five-year period. Second, we estimate the expected decrease of fertility, employing information gathered in the questionnaire. And third, numerical point estimates, supplied by the meta-experts, are utilized to estimate future fertility decline. Combining information from three different sources, from qualitatively very different sets of data, we are able to provide a new set of fertility assumptions to feed into the IIASA/Oxford education projections.

5.3.1 Model 1: Historical Analogy

While countries experience fertility declines at many different paces, patterns of fertility decline had been generalized extensively in the demographic transition literature (Kirk 1996; Dyson 2010b). In early stages of fertility transition, due to improvements in child mortality, patterns of breastfeeding, improvements in fecundity and other factors, fertility tends to increase moderately before couples anticipate the increasing health and survival of their offspring. Women with higher average education generally act as forerunners, as formal schooling pushes advancements in female and child health and new norms regarding family size emerge. The early stage of fertility transition is followed by a period of rapid fertility decline, which tends to slow before fertility reaches replacement level. Exploring historical data broadly confirms this over-simplified description of phases in fertility transition. However, variation across countries in the original level of fertility, the speed of transition, and the duration stayed in each phase of transition, is enormous. Country-specific characteristics determine patterns in demographic transition, including political commitment to family planning, changes in educational systems, economic performance, fertility preferences, female autonomy, gender equity; old age security, and kinship systems. Nonetheless, cross-country similarities dominate cross-country variation, so it is advantageous to learn from the past experiences of countries that have already gone through demographic transition.

Employing past levels and decreases of fertility across countries, we develop a model of historical analogy. The overarching idea can be summarized as follows: Take a country's level and decrease of fertility in the past 5-year interval and compare it to all countries that have undergone similar levels and decreases of fertility in the period since 1970. Since greater access to and adoption of modern means of contraception, as well as family planning programs, were limited across many world regions in the period before

1970 (Freedman and Berelson, 1976), we disregard earlier records. We are aware of the argument that the world today, with its political systems, mortality and morbidity influenced by HIV/Aids, globalization, and the emergence of family planning, can't be compared to circumstances in 1970. Utilizing information across a time-horizon of 40 years might not be the optimal way to learn from past experience; however, we decided in favour of drawing from a larger set of countries going through a similar process, as compared to shortening the time-horizon or even dropping historical observations.

Historical time-series were taken from United Nations World Population Prospects, 2010 (UN, 2011). Employing total fertility estimates for 5-year intervals, we generate percentage changes in fertility decline for adjacent periods. The predicted percentage change of fertility for country $i1$ in projection period $t1$ can be described as the median percentage decrease of all countries j, in any period s.

$$\%\Delta TFR_{i1,t1} = \frac{TFR_{i1,t1} - TFR_{i1,t1-1}}{TFR_{i1,t1-1}} = Median\left(\frac{TFR_{j,s} - TFR_{j,s-1}}{TFR_{j,s-1}}\right)$$

$$\forall\, j \neq i1\,, j = 1, \dots, n, s = 1, \dots, n$$

$$s.t.\, 0.9 \times TFR_{i1,t1-1,} \;>\; TFR_{j,s} \;< 1.1 \times\; TFR_{i1,t1-1,}$$

$$\%\Delta TFR_{i1,t1-1} - 0.05 > \left(\frac{TFR_{j,s-1} - TFR_{j,s-2}}{TFR_{j,s-2}}\right) < \%\Delta TFR_{i1,t1-1} + 0.05$$

$where$

$$j = Afghanistan, Albania, \dots, Zimbabwe= \\ = all\ countries\ where\ UN\ POP\ provides\ historical\ estimates,$$

$$s = (1970 - 1975), (1975 - 1980), \dots, (2005 - 2010)$$

$$i1 = Afghanistan, i2 = Algeria, \dots, in = Zimbabwe == \ set\ of\ high\ fertility\ countries$$

$$t1 = (2010 - 2015), t2 = (2015 - 2020), \dots, tn = (2095 - 2100)$$

The first constraint above guarantees that a country's predicted decrease of fertility is exclusively compared to countries that have experienced a similar level of fertility (+/- 10 percent) at any period y. The second constraint refers to considering only countries that were exposed to comparable decreases in fertility (+/- 5 percentage points) in period y. By restricting the set of countries used for predictions to a subset of countries with similar level and decrease of fertility, we hope to achieve a sufficiently high degree of commonalities relative to countries from which we "borrow" percentage fertility decrease. Defining the interval of +/- 10 percent of a country's fertility level was chosen after comparing current fertility estimates of different sources (UN vs. Population Reference Bureau (PRB) 2010). Differences in 2010 account for an average of seven percent across our set of high fertility countries and can be as high as 54 percent (for Western Sahara). Choosing +/-5 percentage points for the second constraint in comparing past percentage decrease arose as a trade-off between ensuring a sufficiently large number of countries to borrow from, and a constraint strict enough to

be binding.. In the first projection period, the average number of countries for estimating fertility decline in each country is almost 83. By 2100 the number drops to 23. If a country fulfilled both constraints in several periods, we took the mean decrease across periods to avoid over-representation of individual countries. The prediction is repeated stepwise for each period until 2100.

5.3.2 Model 2: Questionnaire Results

Having received 140 responses to the high-fertility module in the expert questionnaire, we developed a model that translates responses from arguments to respective changes in fertility. Respondents were invited to evaluate the arguments toward 2050. As described in Basten et al. (2013), responses from the experts are weighted by their validity and summed up to an aggregate argument score for each expert. Also, experts were asked to provide numerical estimates for their country of choice in 2030 and 2050. The construction of the arguments allows drawing a positive association between the expected decrease in fertility and the value of the aggregate argument score. In other words, the lower the aggregate argument score (AGGSCORE), the stronger the expected decrease in fertility.

For modeling the expected relative decrease in fertility, we calculated the median response across experts p within each country i. Countries with multiple experts enter the regression with a weight w, which represents the number of experts available in the respective country. The regression is estimated using STATA 12, using the "analytic" weights function, where the variance is assumed to be σ^2/w_i, meaning that the weight is inversely related to the variance of the ith observation. Using the "analytic" weights function is a common method to overcome heteroskedastic errors. [13]

We formulated the following model:

$$\%\Delta TFR = \beta_1 \times AGGSCORE + \varepsilon$$

$$where\ AGGSCORE = median(AGGSCORE_p)$$

The resulting $\beta_1(0.15(0\ .009))$ (see Figure 9) can be interpreted as the average predicted relative change in fertility from 2010 to 2050. By applying the regression coefficient β_1, we calculate the predicted percentage change in TFR, using the median aggregate argument score for each country. It would be desirable to estimate this regression separately for countries, starting at higher levels of fertility in 2010, as compared to countries already close to replacement level. However, due to the relatively small number of countries (37), it was not possible to run the regression for smaller sub-sets of data.

In a last step, we decompose the predicted change in TFR from 2010 to 2050 in compound rates of decrease, yielding eight 5-year rates of change r for each country i.

$$TFR_{2010} \times \hat{\beta}_{1i} = TFR_{2050,experts}$$

$$\hat{\beta}_{1i} = (1 + r_i)^8$$

[13] Further details can be found here http://www.stata.com/support/faqs/stat/crc36.html

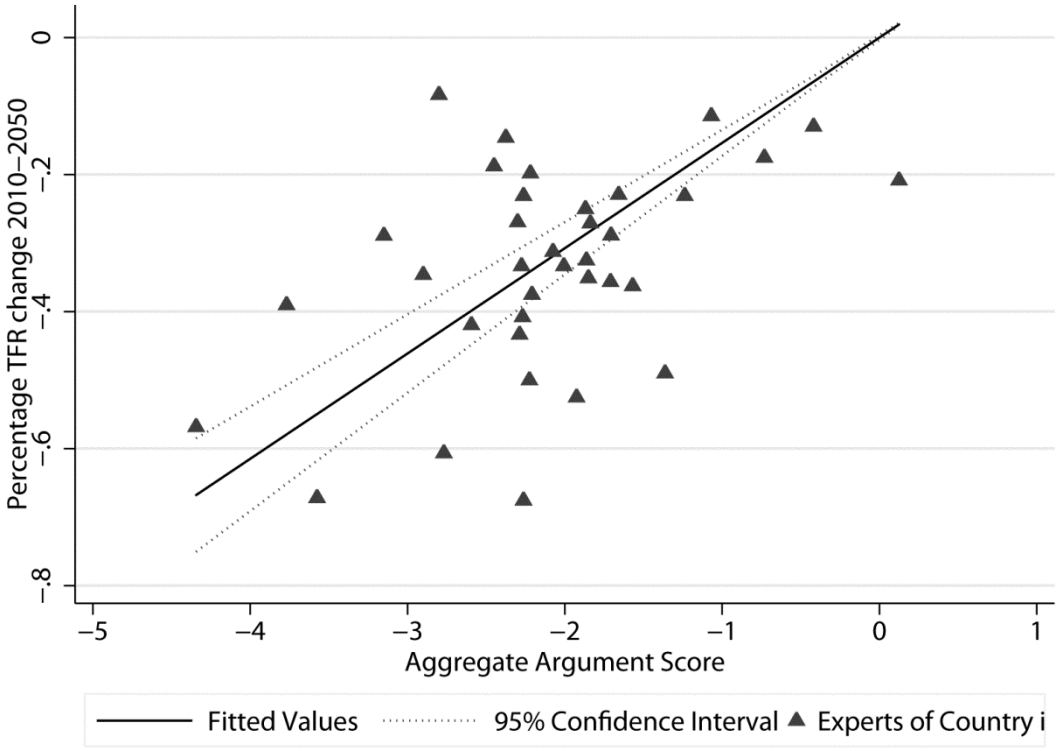

Figure 9. Predicted percentage change in TFR, 2010-2050, $\%\Delta TFR = 0.15(0.009) \times AGGSCORE$; Adjusted R2=0.87

5.3.3 Model 3: Meta-expertise

During the meeting with meta-experts in Dhulikhel, Nepal, we not only gained further insights into the most important drivers of fertility across world regions, but also formulated numerical estimates of fertility for 14 countries in 2030 and 2050 (Bangladesh, Egypt , Ethiopia, Ghana, India, Indonesia, Nepal, Niger, Nigeria, Pakistan, Philippines, South Africa, Uganda, and Yemen). Unlike the model from the experts, we calculated two rates of decrease, one from 2010 to 2030 (r_1) and another from 2030 to 2050 (r_2).

$$TFR_{2010} \times (1 + r_{1i})^4 = TFR_{2030,meta-experts}$$

$$TFR_{2030,meta-experts} \times (1 + r_{2i})^4 = TFR_{2050,meta-\ experts}$$

5.4 Combining the Models

In a final step, we developed a method of combining estimated fertility decreases of all three models. While the model of historical analogy can be implemented in all countries in the cluster of high-fertility countries, we estimated rates of fertility change for 37 countries from the expert questionnaire model, and another 14 trajectories from the meta-expert model (the models partially overlap). Thus, for countries where we did not have an expert model, we applied only the model of historical analogy. The following weighting scheme yielded a percentage change in fertility for 5-year periods from 2010 to 2050.

	Historical Analogy %ΔTFR_1	Expert Model %ΔTFR_2	Meta-Expert Model %ΔTFR_3
	α_1	α_2	α_3
Relative Weight	1	1	0.2 x # of experts

For each projection period, we first calculate model 1, weight the percentage decline with results from models 2 and 3, and then deduct the weighted percentage change from TFR_{t-1}.

$$TFR_t = TFR_{t-1} + \alpha_1 \%\Delta TFR_1 + \alpha_2 \%\Delta TFR_2 + \alpha_3 \%\Delta TFR_3$$

$$\alpha_1 + \alpha_2 + \alpha_3 = 1$$

This process is repeated for all t until 2045-2050. After 2050, only model 1 applies. If a country's fertility reaches 1.6 or below in the period 2010-2100, the model estimates are replaced by linear convergence towards 1.75 in 2200. If a country does not yield 1.6 or below by 2100, we imply linear convergence to 1.75, starting in the period 2100-2105. The benchmark of 1.6 was chosen after calculating mean fertility of all countries below replacement level that had experienced positive growth rates in the successive 5-year interval period. Alongside, we observed minimum fertility of all countries that reached sub-replacement fertility. Countries that had experienced positive growth rates entered the sample only once because if a country showed alternate fertility patterns (i.e. short recovery followed by a successive decrease and recovery), only the first period before the first recovery was considered. The resulting average fertility was 1.67 and can be interpreted as the mean level of sub-replacement fertility, before positive growth rates were measured in the next 5-year interval. In applying this method we disregarded countries that have not yet experienced a fertility recovery and face further declines; i.e. China is not included in the calculation of the turning point. Calculating minimum fertility of all countries below replacement level yielded a value of 1.57. Given that in the calculation of minimum fertility, 29 countries in the sample had not yet experienced a fertility recovery and fertility could possibly decline further, we decided to adopt 1.6, a value closer to the minimum observed fertility.

Figure 10 displays fertility transition pathways of all countries that have experienced levels below replacement fertility followed by a period of increasing fertility rates. Choosing the benchmark of 1.6 follows the same reasoning as modeling rates of fertility decline in the model of historical analogy (model 1). Rather than picking an arbitrary level of fertility, the benchmark is a result of analysing historical fertility trajectories worldwide. The sample of countries that have at some point experienced below replacement fertility, followed by a period of positive growth rates, covers 55 countries across all continents. Generating minimum fertility of all countries below replacement fertility includes 84 countries.

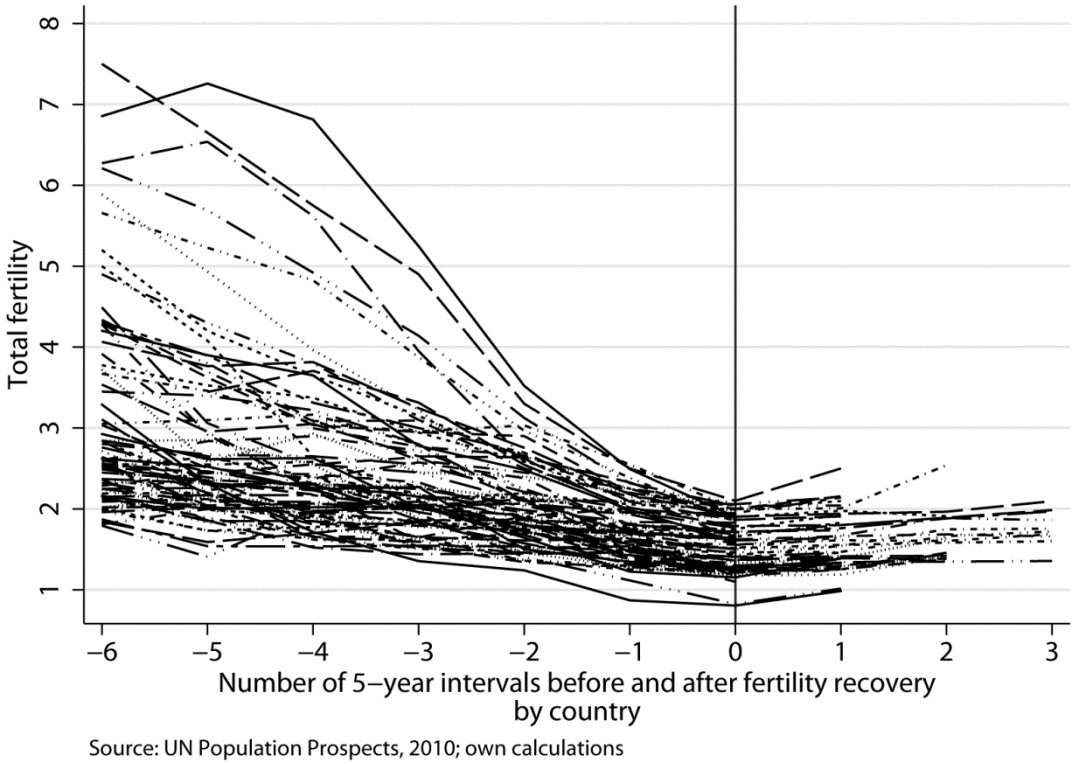

Figure 10. Pathways of fertility decline and recovery, by country

5.5 Results

Here, we show results from this model. As discussed, the fertility scenarios are constructed from a model of historical analogy and a model from the expert questionnaire and the meta-experts' estimates. All figures presented here show historical fertility records since 2000. While the model employs observations of fertility since 1970, the graphs disregard records before 2000. The United Nations (United Nations 2011) 5-year period fertility is labelled with squared markers. In the first interval, we produced fertility scenarios for 2010-2015. Baseline model results, generating a scenario without expert judgment, produces fertility estimates labelled with round markers. The final fertility scenario, combining model results and expert model estimations, is displayed with diamond markers.

Figure 11 show model outcomes for two countries in West Africa, Ghana, and Nigeria. Fertility in the period 2005-2010 is 4.3 for Ghana and 5.6 for Nigeria. The historical model outcomes suggest rapid fertility decline; values in the period 2025-2030 are 2.7 for Ghana and 3.5 for Nigeria. Completing the model with estimates from experts and meta-experts decelerates the expected speed of decline from the baseline model. On average, experts on Ghana suggest slower fertility decline compared to the historical model. Relative to other countries, experts evaluated socioeconomic change with regard to fertility more conservatively than in other countries (values of aggregate score from the questionnaire are not shown here). The meta-experts also gave values of

fertility that were higher than the model results. As a consequence, the original historical model results were shifted up, resulting in fertility scenarios close to the UN's fertility estimates until 2050. The situation in Nigeria is similar. Relative to the historical model, experts and meta-experts suggest substantively slower fertility decline in Nigeria and thus, the combination of all three models results in higher fertility.

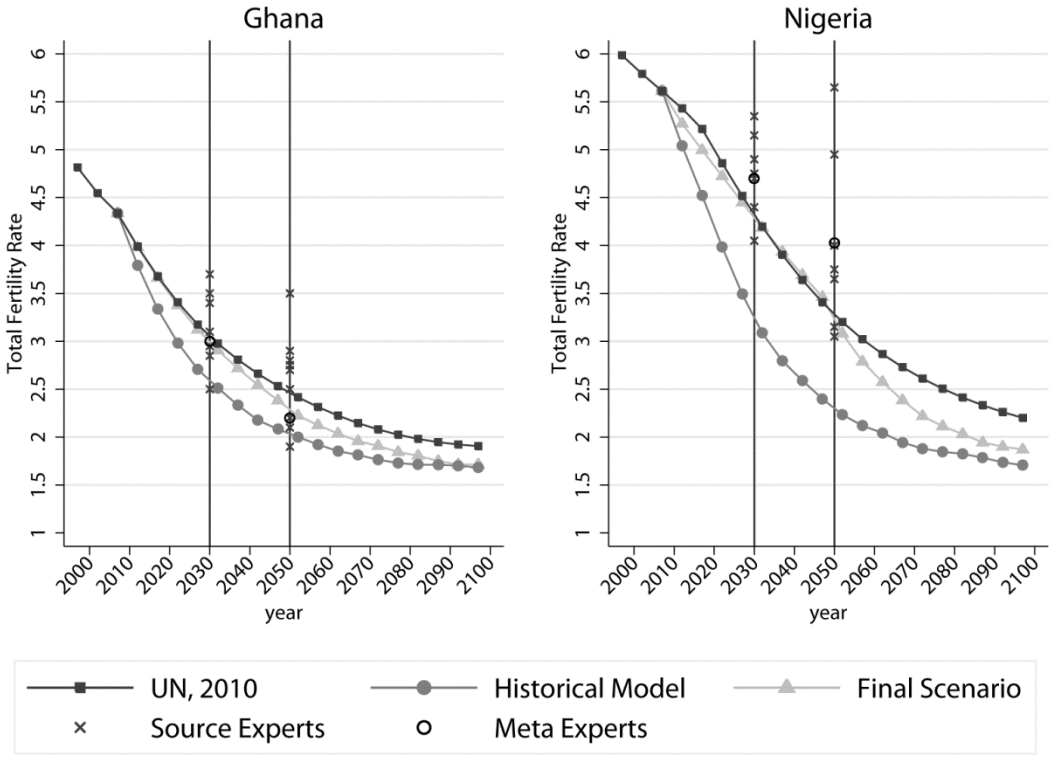

Figure 11. Historical fertility and fertility scenarios for Ghana and Nigeria, 1990-2100

Figure 12 displays fertility scenarios for the East African countries Ethiopia and Kenya. Compared to UN's fertility scenarios, our joint models produce fertility that is higher than both the historical model and the UN estimates. In Kenya, there are no numerical estimates from the group of meta-experts, thus the final fertility scenario is only constructed by weighting the historical model and the two source experts, resulting in an increase in the fertility estimates.

Comparing the results in Figures 11 and 12 show results from countries with a varying number of experts. While there are only two source experts for Ethiopia and Kenya, we are able to employ questionnaire results from six experts in Ethiopia and nine experts in Ghana. By definition of the weighting scheme in combining the models, source experts in Nigeria and Ghana have a much higher joint weight than in Ethiopia and Kenya, relative to the historical model and the meta-experts. Keep in mind that the relative weights for meta-experts' estimates and the historical model being 1 each. That means, for example, that in Ghana the expert weight is 0.47=1.8/3.8 (9 experts * 0.2 / (1+1+1.8)), and in Ethiopia the respective value is 0.17=0.4/2.4 (2 experts *0.2 / (1+1+0.4)). The weighting scheme explicitly reflects the number of experts answering the questionnaire. Fertility trajectories of countries with large numbers of experts predominantly rely on the expert judgment from the questionnaire. For countries where

we have little expert knowledge we instead put more weight on the historical model and the meta-expert estimates.

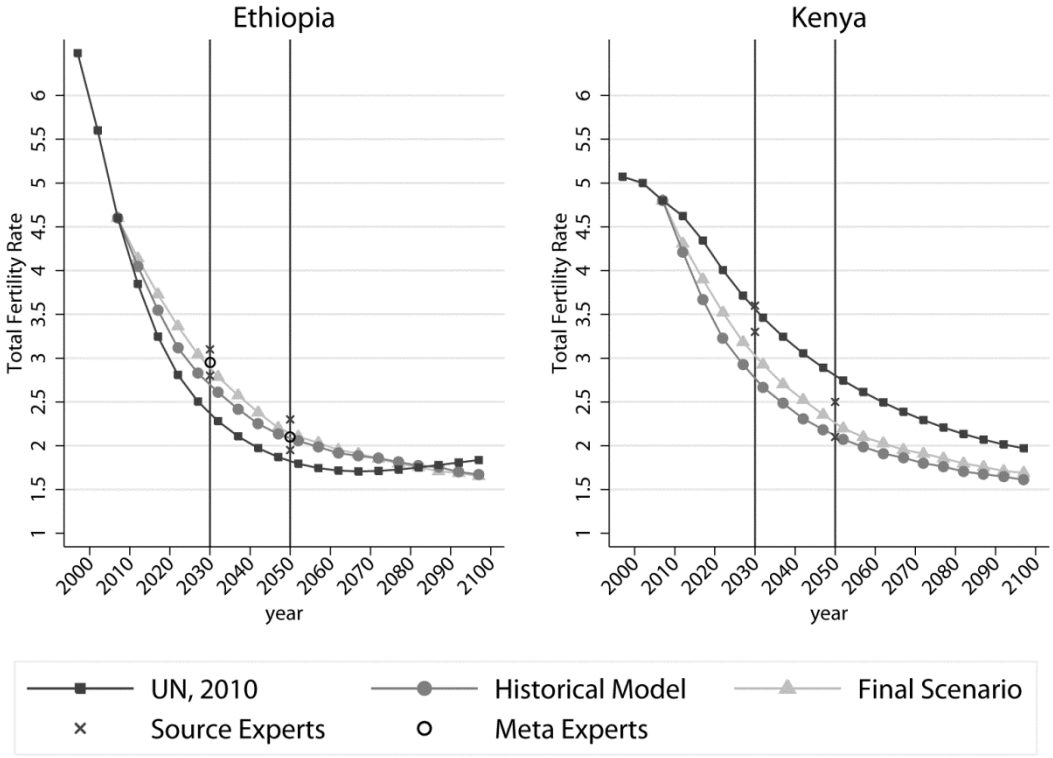

Figure 12. Historical fertility and fertility scenarios for Ethiopia and Kenya, 1990-2100

Having discussed Latin America's advanced stage in fertility transition in the first section of this paper, we now show potential pathways of completing demographic transition for Bolivia and Venezuela. Venezuela begins at 2.5 in the period from 2005-2010, while the UN estimate of Bolivia's fertility in the same period is 3.5. For both Bolivia and Venezuela only one expert filled out a questionnaire. As a result, the expert's weight is limited and has little impact on the overall trajectory of fertility transition In the case of Venezuela, the expert model generates a slightly faster fertility decrease than we get from the historical model. The expert in Bolivia left us with very high fertility estimates for 2030 and 2050, and together with the judgment from the arguments, fertility decline is expected to happen at a slower pace than calculated from the historical model. The fertility scenarios suggest level sub-replacement fertility by the 2020-2025 period in Venezuela, and by the 2045-2050 period in Bolivia (Figure 13).

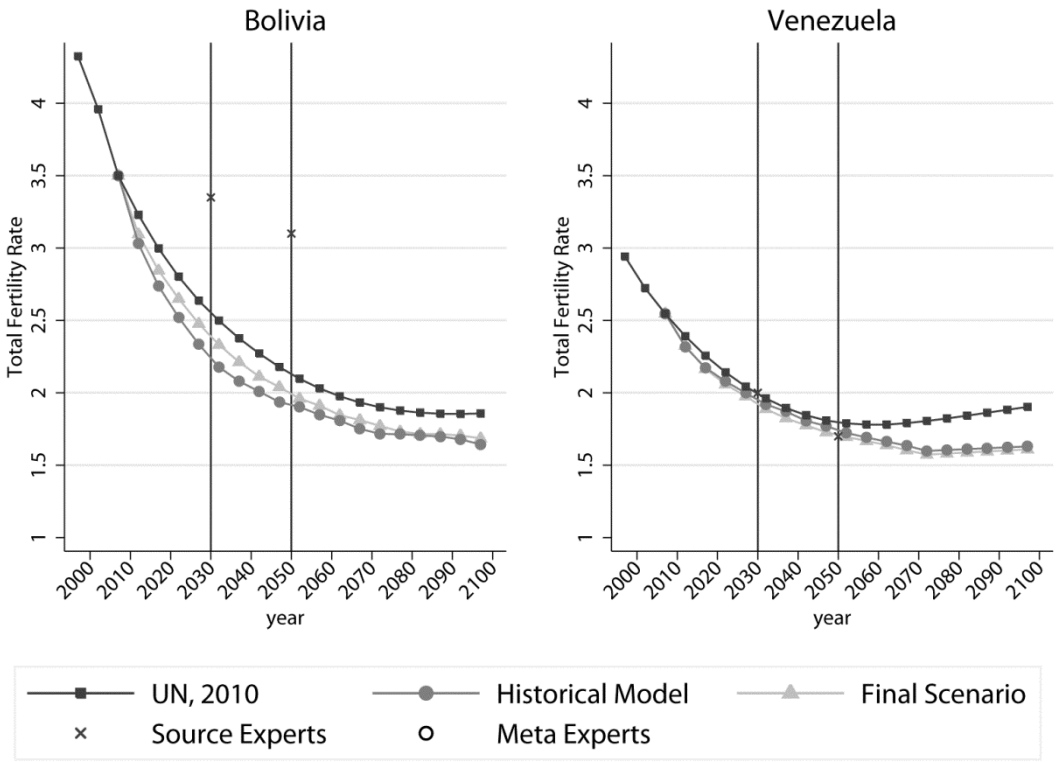

Figure 13. Historical fertility and fertility scenarios for Bolivia and Venezuela, 1990-2100

Fertility scenarios for India and Bangladesh are shown in Figure 14. India is characterized by a large number of experts (25). While meta-experts estimated India's fertility sub-replacement levels before 2030, the large number of experts and their less progressive views produce, through combining the models, fertility estimates of 2.2 in the period 2025-2030, and 1.88 in 2045-2050. In contrast, expert and meta-expert models drive model estimates downward in Bangladesh. Fertility drops below 2 in the period 2015-2020, and reaches 1.65 in 2045-2050.

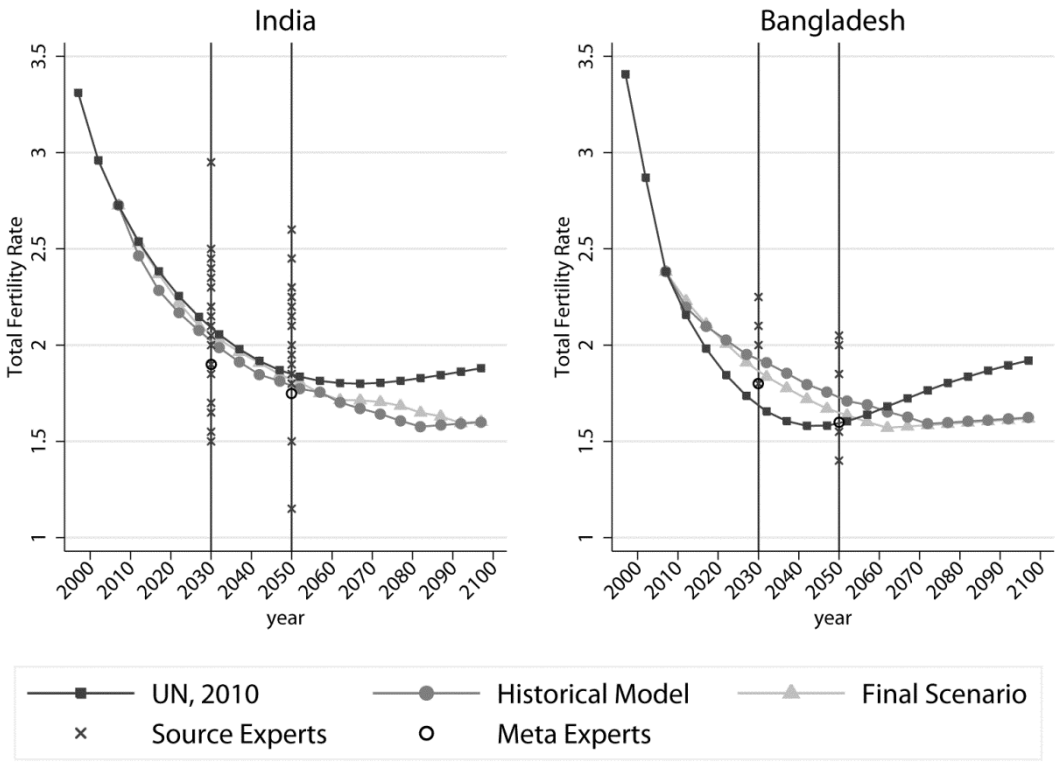

Figure 14. Historical fertility and fertility scenarios for India and Bangladesh, 1990-2100

6 Conclusions

About half the world's population currently lives in countries where women of childbearing age have below-replacement fertility (United Nations 2011). The key for future population growth lies with the other women, those in high or intermediate fertility countries where fertility is still above replacement levels. With a 30-year time lag between the moment the world reaches below-replacement fertility and the time population starts declining, these women's fertility will largely determine if, when, and at which level the world population will finally peak. We have shown in this paper that most regions of the world have yet to reach intermediate levels of fertility, and that the last two regions with high levels of fertility are sub-Saharan Africa and South Asia. Africa is the most problematic and the evidence indicates that the socioeconomic conditions in many countries in terms of political governance, low levels of education, and under-performing economies do not favour rapid future declines in fertility. On the contrary, the experts consulted for this exercise anticipated further declines in fertility rates in other regions as they considered the continuous spread of women's education, modern family planning and rapid urbanization as factors inducing further reductions.

In the theoretical section of this article, we highlight women's education as the main influence on their fertility. At the middle stage of the demographic transition, where the several society strata are spread out across different stages of transition, the role of education is most pronounced, with the highly educated having considerably

lower fertility than the less and not educated. As the fertility transition proceeds to low levels of childbearing, the differentials then tend to disappear, which was pointed out by Cleland (2002) when describing the association between education and fertility as a transient phenomenon. Nevertheless, the impact of education will prevail for several decades as many countries find themselves at or approaching the mid-transitional stage. Also, as described in Basten et al. (2013), differential fertility by education does not entirely disappear in many countries and is not expected to do so in the future.

The future fertility assumptions developed in this paper are based on a model that takes the level and recent trends in fertility into consideration and is further informed by the numerical estimates of experts obtained through an online questionnaire and a meeting. Beyond the argumentation on the predictors of future fertility declines, the results show that out of the 117 countries that had strictly above-replacement fertility in 2010 – set conventionally at 2.1 – there would be only 71 in 2030 and 42 in 2050. In 2060, out of the 17 countries where women are expected to bear more than 2.1 children, only five will experience fertility above 2.5. Four are sub-Saharan Africa (Niger, Nigeria, Uganda, and Malawi) and one is in South Asia (Afghanistan). Two-thirds of the countries that had very high levels of fertility in 2010 are expected to converge to below-replacement fertility in 2060.

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Appendix

Appendix Table A1: List of qualitative statements (arguments) in the high fertility questionnaire.

CL 1 Cultural Change in ideal family size (CULTURAL)	
HF1-1	Family size decisions will increasingly be made by couples themselves rather than surrounding networks
HF1-2	Religions and religious beliefs will become more important for fertility decisions
HF1-3	The traditional preference for boys will eventually disappear
HF1-4	The government will take leadership in promoting the idea of small family size
HF1-5	Negative attitudes towards modern methods of contraception will diminish
HF1-6	Childlessness will become socially acceptable
HF1-7	Educational differentials in desired family size will diminish
CL 2 Health and Child Survival (HEALTH)	
HF2-1	Adolescent pregnancy will become less frequent
HF2-2	There will be increasing access to improved sanitation and health care for mothers and children
HF2-3	Parents will expect that most of their children survive to adulthood
HF2-4	Mothers will increasingly see the benefits of birth spacing
CL 3 Status of women in family and society (STATUS)	
HF3-1	Marriage arranged by parents or relatives will lose ground
HF3-2	Female educational enrolment rates will increase
HF3-3	Male partners will become more supportive of modern contraceptive use
HF3-4	The age at first marriage will continue to increase
HF3-5	The participation of women in the labour force will increase
HF3-6	More women will decide to stay unmarried
HF3-7	Women will increasingly be able to decide on their own about using contraceptives
CL 4 Economic costs and benefits (COST)	
HF4-1	Pension funds and social security systems will replace family support in old age
HF4-2	Parents put increasing value on good education of their children
HF4-3	Mothers will increasingly return to paid employment even when their children are small
HF4-4	The cost of raising children in urban settings will increase
HF4-5	The gap in access to education of boys and girls will be removed
HF4-6	The prevalence of child labour will decline
CL 5 Reproductive Health (RP HEALTH)	
HF5-1	The availability of modern family planning services will significantly increase
HF5-2	Convenient contraceptives without side effects will become broadly available
HF5-3	Traditional methods of family planning will remain/become widespread
HF5-4	Abortion (whether legal or illegal) will be more widely practiced than today
HF5-5	Modern contraception will be banned for religious, political or other reasons
HF5-6	Educational differentials in actual fertility will diminish

Appendix Table A2: Numerical estimates by country and number of respondents in 2030 and 2050

Country	# Respondents	TFR 2030	TFR 2050	Country	# Respondents	TFR 2030	TFR 2050
Afghanistan	1	4.0	1.9	Nepal	9		1.8
Bangladesh	6	1.9	1.6	Nepal	10	2.2	
Bhutan	1	2.1	1.9	Niger	1	6.8	6.4
Bolivia	1	3.4	3.1	Nigeria	6	4.7	3.8
Botswana	1	2.8	1.1	Oman	1	2.5	2.0
Burkina Faso	1	5.7	5.0	Pakistan	4	3.3	
Ecuador	1	2.2	2.0	Pakistan	5		2.9
Egypt	5	2.4	2.0	Papua New Guinea	1	3.1	2.5
Ethiopia	2	3.0	2.1	Peru	1	2.1	1.9
Ghana	10	3.2	2.6	Philippines	3	2.8	2.4
Haiti	1	3.2	2.8	Rwanda	2	4.0	3.5
India	30	2.1	1.9	Senegal	1	3.5	2.5
Indonesia	4	2.1	1.8	South Africa	2	2.1	1.9
Kenya	2	3.5	2.3	Sri Lanka	1	1.9	2.0
Lesotho	1	2.8	2.6	Sudan	1	3.8	3.2
Malawi	3	4.5	3.2	Suriname	2	2.0	1.9
Malaysia	3	2.1	2.0	Tanzania	1	4.4	3.5
Mali	1	3.0	2.9	Uganda	4	5.3	4.3
Mongolia	1	2.4	2.4	Venezuela	1	2.0	1.7
Morocco	1	1.8	1.8	Vietnam	3	1.7	1.4
Mozambique	1	4.8	4.4	Zambia	1	5.1	3.6