



LUND UNIVERSITY

Department of Economic History

Master Programme in Economic Demography

*Persistent High Fertility in Sub-Saharan Africa –
A Comparative Analysis of Patterns and Drivers
in Niger and Senegal between 1992 and 2006*

Course: EKHR52

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Date: 1st June 2013

Abstract

This thesis aims to examine the link between socio-economic factors and persistent high fertility in Niger. A national comparison with Senegal – an early fertility transition country – serves as reference point to understand the phenomenon on the basis of associated fertility patterns and drivers. Expertise on child-bearing behavior can guide policy intervention, which in turn mitigates negative consequences of persistent high fertility. Multivariate linear regression analysis is applied to investigate cross-sectional and pooled cross-sectional models in order to detect underlying patterns and drivers regarding the number of children ever born. The utilized micro level data originates from the Demographic and Health Surveys (DHS) between the years 1992 and 2006 for Niger as well as 1992-1993 and 2005 for Senegal. Significant inter-country differences emerge among the variables child death, respondent's education and household durables. In prospective research it might be possible to address whether national level analysis masked regional disparities in reproductive behavior.

Keywords: persistent fertility, sub-Saharan Africa, DHS data, socio-economic

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1 Introduction¹

This chapter endeavors to familiarize the reader with background to the research and then present the research question at hand. It will first give insight into how fertility developed in some sub-Saharan African countries and what research has shown to date. Then, the study will be presented with the research question, followed by the scope and aim of the present research. The introduction closes with the outline of the thesis.

1.1 Research Problem

“A woman without children is like a tree without leaves”

Proverb by the Barma – an ethnic group in Chad (Reyna, 1975, p.57)

The Barma proverb gives a positive impression of the cultural value of fertility in Chad and the value of family size. In spite of this culturally imbedded proverb, the fertility trend in sub-Saharan Africa (SSA) has changed. A case study by Ortega (2008) in this area, determined on the basis of United Nations (UN) data, showed that there was a fertility turning point in the period 1960 to 1965. Although, according to Schoumaker (2009) the majority of other developing countries in the same area displayed a decrease in total fertility rate (TFR). However, some countries, such as Niger, resisted this trend for some time. The reason for the persistent high fertility in SSA, has yet to be solved, although, some studies have shown a variety of variables, such as low income, education and health (Fayissa, 2001; Bongaarts & Casterline, 2013). Conversely, Caldwell & Caldwell (1990) argue that the underlying causes for the persistent high fertility in this area includes other factors with the main one being kinship. Furthermore, their study showed that a number of Asian countries achieved to diminish high fertility patterns despite similar obstacles. Therefore, there must be more variables underpinning the diminished high fertility patterns in SSA.

This study attempts to investigate fertility behavior in SSA. The research question attempts to investigate how socio-economic determinants of fertility differ between Niger and Senegal. Starting point for the investigation is the similarity of fertility rates around the year 1975. According to UN data (2013), Senegal’s fertility decreased from 7.5 children per woman in the period 1975-1980 towards about 5 children per woman in 2005-2010. During the same two periods, the fertility decline in Niger experienced a small drop from slightly more than 7.6 to around 7.2 children per woman. This is a difference of 2.2 children per woman.

¹ I would like to thank Kaveh Majlesi and Julienne Stewart-Sandgren for their insightful guidance throughout the writing process.

Apart from data availability, the primary decision for Senegal as benchmark for analyzing the case of Niger is the above indicated gradual and irreversible decline in fertility among Senegalese women since the mid 1970s (see Appendix 1). In addition, the relative similarity of both countries is useful since potential confounding factors may be avoided. Similar characteristics include geography, colonial history, cultural setting and social factors with emphasis on kinship patterns. The latter is frequently mentioned as a special feature regarding fertility behavior in SSA (see Isiugo-Abanih, 1985; Vandermeersch, 2002; Akresh, 2009). Finally, the decision for Senegal was also influenced by an obvious lack of comparative research involving the country.

The urgency to deal with persistent high fertility results from a variety of negative implications. With regard to the UN Millennium Development Goals (MDG) indicates the World Bank development report for Niger that regardless of the underlying scenario “[...] the targets were not sufficient for Niger to achieve the poverty MDG of halving poverty by 2015” (World Bank, 2012, p.97). MDG include the provision of universal primary education, the reduction of child mortality and the enhancement of maternal health, among others. According to the World Bank (2010, 2012), the achievement of the MDG is hampered by increasing mortality risks during infancy and early childhood due to high-order as well as closely-spaced births. The same criteria represent higher risks for maternal health. Furthermore, the World Bank (2010) finds that children from larger families obtain less schooling. Likewise, the World Bank report indicates that cohort size determines school quality due to per pupil expenditure, class size and student-to-instructor ratio. Declining fertility increases per pupil investments and contributes to a demographic dividend (World Bank, 2010). That is, successively smaller birth cohorts form a bulge among the working age population which increases per capita productivity. In turn, persistent high fertility and ensuing population growth represent an excessive burden to natural resources, for instance fresh water supply.

It is of critical importance to recognize the individual drivers for child-bearing. Expertise serves for the clarification of new population policies or the adjustment of existing population policies in order to deal with demographic dynamics. The strategy to obtain this expertise is to identify differences in drivers of fertility variation between a pre-transitional and an early-transitional country. Which socio-economic variables are responsible for the early-transition in Senegal, and how do they differ from the drivers in Niger? Ideally, the findings of this study contribute to tackle excessive family size in Niger, but possibly in other persistent high fertility countries too.

1.2 Aim and Coverage

This study contributes to existing research by reviewing factors of reproductive behavior in Niger and Senegal between 1992 and 2006. The aim is to examine possible differences in those factors which may explain the persistence of high fertility in Niger. Previous literature guided the formulation of the research hypotheses. Cross-sectional and pooled cross-sectional data is investigated with the help of multivariate linear regressions. The focus is on socio-economic variables.

1.3 Outline

This study is organized as follows. The next chapter presents the theoretical framework to the study by combining fertility theory and various explanations for the emergence of fertility decline. Besides, this chapter includes country-specific information and presents a review of previous research in SSA before concluding with the formulation of the research hypotheses. Chapter 3 provides details about the source material and the utilized samples. The methodological part in chapter 4 considers the multivariate model and the associated socio-economic variables. Chapter 5 demonstrates and discusses the estimation results. Chapter 6 concludes.

2 Theoretical Framework and Previous Research

Chapter 2 begins with an overview of the respective country's characteristics. It includes economical, geographical and historical information in order to illustrate the factors that contribute to the socio-economic background of both Niger and Senegal. Next, the relevant literature is reviewed that highlights the studies to date and the determinants of fertility behavior in SSA. Then, the theoretical background is presented. It provides knowledge on fertility behavior within a microeconomic household model as well as via innovations and adjustment processes. Finally, three research hypotheses are formulated that guide the empirical analyses.

2.1 Country Profiles

Demographic, economic and geographical information for Niger and Senegal is presented in this section. Unless otherwise noted, the following information has been excerpted from the Central Intelligence Agency (CIA) Factbook 2013.

Both, Niger and Senegal are situated in West Africa which is decisive due to regional fertility differentials in SSA. Concerning their location both countries have in common that they are adjacent to the Sahel zone, a semiarid climate area that covers northern Africa between the Atlantic Ocean and the Red Sea (for details see a map in Appendix 2). However, a profound difference lies in the fact that Niger is landlocked while Senegal has a coastline of 531 km (TNAI, 2013). Location suggests being decisive for market access and links simultaneously to foreign direct investment (FDI) as well as global trade. Interestingly, trade can impact fertility rates. Empirical studies, for instance Gries & Grundmann (2012), discovered with the help of a panel regression model that manufacturing exports lower fertility in contrast to primary exports that have a positive or no such effect. The reason is that the dominance of low-skilled labor - that produces primary exports - opposes incentives to invest in the education of children and appears instead favorable for child labor.

Several demographic, economic and geographical characteristics intend to illustrate inter-country differences and similarities (see Table 1). Major economic differences include GDP per capita and import revenues that are more than twice as high in Senegal compared to Niger. The total life expectancy is six years higher in Senegal, by which family planning and the desired number of children could be substantially influenced. Zhang & Zhang (2005) suggest that "For developing countries with low life expectancy and low per capita income

but high birth rates, efforts on reducing mortality have good payoffs [...]” (Zhang & Zhang, 2005, p.65). Besides, the authors indicate that long-term planning possibilities induce economic growth, diminish fertility rates, and cause larger demand for education as well as higher saving rates.

Despite the larger geographical area of Niger, land use is similar with regard to arable land. However, the share of agriculture within the GDP composition by sector is in Niger more than twice as high as compared to Senegal. This is interesting with regard to the extensive employment of females in agricultural work (Caldwell & Caldwell, 1990). A scenario could be that wage differentials exist between the economic sectors with inferior earnings in agriculture. As a result, the incentive for large progeny could be more worthwhile in order to compensate for this wage differential. Parents could receive additional income through intergenerational wealth transfers. The size of the agricultural sector could facilitate such flows due to better opportunities for child labor, although the educational expansion might counteract child labor. In addition, the assumption of a male-female income disparity decreases the negotiation position of women with their husband or kinship regarding the number of desired children. Access to electricity - a key factor representing development - might mitigate male-female income disparities. The provision of electricity could provide enhancements in education or economic activity. For instance, refrigerators could be in need to store ingredients which later become processed to market goods. Similarly enables electricity the usage of electrical items for production. The consumption of electricity and the number of internet users is in Senegal many times larger than in Niger. Intra-household investments could be in conflict between durables, such as radios, computers or refrigerators and offspring. Besides, internet access or other information mediums might be helpful in order to obtain advice with regard to contraception practices.

Table 1: Country indicators Niger and Senegal (CIA, 2013)

Indicator	Niger	Senegal
Area (land & water)	1.267 million sq km	196,722 sq km
Arable land (2005)	11.43%	12.51%
Crude oil production (2011)	6,712 bbl/day	0 bbl/day
Education expenditures (2009)	4.5% of GDP	5.8% of GDP
Electricity consumption (2009)	695.3 million kWh	2.123 billion kWh
Ethnic groups (three most frequent)	Haoussa 55.4%, Djerma Sonrai 21%, Tuareg 9.3%	Wolof 43.3%, Pular 23.8%, Serer 14.7%
Exports (2012)	\$1.654 billion	\$2.458 billion

GDP per capita 2012 (PPP)	\$900	\$1,900
GDP composition by sector (2012)	Agriculture: 39.6% Industry: 17.1% Services: 43.2%	Agriculture: 15.3% Industry: 22.7% Services: 61.9%
Imports (2012)	\$2.491 billion	\$5.109 billion
Industrial production growth rate	5.1% (2003)	4.9% (2011)
Infant mortality rate – per 1,000 live births (2012)	89.7 deaths	55.2 deaths
Internet users (2009)	115,900	1.818 million
Life expectancy at birth (2012)	53.8 years	60.2 years
Literacy – total, men, women	28.7%, 42.9%, 15.1% (2005)	39.3%, 51.1%, 29.2% (2002)
Median age – total (2012)	15.2	18.2
Paved roadways (2009)	3,912 km	4,099 km
Population (2012)	16,344,687	12,969,606
Population growth rate (2012)	3.36%	2.53%

Note: bbl - barrel

Summarizing the information from Table 1, the characteristics of Senegal suggest a higher level of development in comparison with Niger. Simultaneously, it becomes obvious that Niger is a far more agriculture-based country than Senegal. Due to the previous characteristics, divergences in child-bearing patterns via the fertility-income link could be promoted between the two countries. More country-specific information for Niger is discussed in the next section.

2.1.1 Niger

To gain an understanding of the cultural background of Niger, it is important to know that it was once a colony established by the French that lasted from 1922 until independence in 1960. Since then, the country experienced many years of single party and military rule. It could be assumed that during this period, Niger's ruling possibly suppressed or showed indifference to the establishment of governmental family planning institutions in order to monitor and control family size. It could also have caused foreign relief organizations to refuse assistance or to tie support on certain political requirements. However in 1993, the first multiparty elections took place. The outcome of the first multiparty elections in Niger describes van de Walle (2000) as imperfect democratization or "pseudo democracy", but mentions also that this might be the onset of more profound changes in the future. Instead, no answer is provided to the question how real changes in African politics may affect family policies.

Since Niger is coined by agriculture and subsistence farming, it is susceptible to frequent natural hazards in the form of recurring droughts. The latter suggests to have an impact on food supplies and consequently on the magnitude of *child mortality*. Furthermore, current environmental issues comprise overgrazing, soil erosion as well as deforestation. These factors might have a negative impact on crop yields and intensify food supply problems, which in turn could have an impact on reproduction behavior. Moreover, natural resources contain uranium, coal, iron and phosphates, among others, in Niger. Exploitation of these resources could possibly generate government revenues. This could in turn create a number of investments that would then see to that food supplies and their associated equal regional allocation take place.

Economically, Niger relies only on a few factors: subsistence crops, livestock as well as uranium extraction. Although 90% of the population is dependent on agriculture, recent reports show the discovery of oil. Though, this is in early exploration stages, there is a foreseeable contribution to a significant future growth. Nevertheless, desertification, drought as well as intense population growth have hampered the economy. The government's current budget consists to almost 50% of foreign donor resources. Simultaneously, large multilateral debt reliefs have been granted, funds for basic health care as well as primary education have been provided, all in order to reduce poverty levels. In 1993, about 63% of the population lived below the poverty line. As a consequence of this level of poverty, human trafficking continues to exist, similarly the exploitation of children and women, for example as domestic servants. However, in spite of poor living conditions, conception remains high.

The population structure of Niger is distributed as follows: 0-14 years 50.1%, 15-24 years 18%, 25-54 years 26%, 55-64 years 3.2% and over 65 years 2.6% (see Appendix 4 for the population pyramid). Thus, half of the population comprises of the lowest age group within the population pyramid. In contrast, the size of age classes beyond 55 years is low. This implies that the majority of the population falls directly before the period of reproduction, which still provides room for maneuver regarding family planning.

2.1.2 Senegal

An important historical similarity between Niger and Senegal is the status as French colony. In 1659, the French had only established trade posts. Until the late 1800s conflicts with the Dutch and the British led to changing rulers of the territory. In 1895 incorporated the French Senegal into French West Africa – a federation of eight French colonial territories. This condition lasted until 1960 when Senegal experienced independence from France. Among

African countries, Senegal belongs to the most stable democracies. For 40 years, until 2000, Senegal was ruled by a socialist party. Since the year 2000 rules a democratic movement the country. The movement changed the constitution more than a dozen times in order to expand their executive power. This political transformation falls within the observation period of the present study. For that reason, the characteristics of the most recent survey participants could be significantly different in comparison to the ones from the two previous cross-sections.

Three major resources constitute Senegal's economic endowments: fish, phosphates and iron ore. However, Senegal faces environmental issues. These include deforestation, soil erosion, desertification as well as overfishing. A scarcity of natural resources suggests especially in developing countries threats to economic development due to absent substitutes, for instance human capital. At the same time, the interaction between fertility, natural resources and economic development remains unclear. Is fertility behavior a consequence or a cause of other basic changes that provoke development? Instead, the consequences of natural hazards on reproductive behavior seem to be more obvious. For instance, seasonally flooded lowlands could facilitate the spread of diseases or provide breeding ground for malaria-carrying mosquitoes. Both factors might lead to increases in *child mortality*, and thus encourage higher fertility.

Concerning the economy has to be mentioned that Senegal counts heavily on donor assistance and foreign direct investment. However, during the period 1995-2007, the real growth in GDP averaged annually over 5%. In order to improve infrastructure and agricultural development, the IMF approved in 2010 a new three-year policy support instrument. Investments in infrastructure are necessary due to unreliable power supply. The latter appears to hamper economic development and consequently promotes unemployment. In turn, unemployment generates migrant efflux, for example towards Europe. In 2001, 54% of the population lived below the poverty line.

The population structure in Senegal is as follows: 0-14 years 43%, 15-24 years 20.6%, 25-54 years 29.9%, 55-64 years 3.7% and over 65 years 2.9% (see Appendix 5 for the population pyramid). Similarly to Niger, the lowest age groups are most pronounced. With ascending age class, the proportion decreases. However, in contrast to Niger, the distribution over the age groups is less pronounced in the initial classes. Instead, the higher composite age specific categories are stronger pronounced which is in accordance with the median age. The latter is with 18.2 years in Senegal larger than in Niger with 15.2 years.

In sum, the country profiles of Niger and Senegal show historical similarities between both countries. Nonetheless, geographic parameters, such as a coastline as well as more recent economic, demographic and political indicators demonstrate partially sizable differences. While both countries still depend largely on external donor assistance, exhibits Senegal more substantial development. This is reflected, among others, in a higher life expectancy as well as by high shares of industry and service in the composition of the GDP.

2.2 Previous Research

Historically, the African culture has been and still is equipped with various incentives and rewarding systems that stimulate a large number of progeny. Caldwell & Caldwell (1987) name factors like prestige or material well-being as being closely intertwined with children. Material well-being is generated by the flow of resources from young to old individuals. Upward wealth flows to parents are large in African society and ensured via religious and social sanctions. Moreover, the authors indicate that the majority of Africans considers fertility as divinity that unites wife, husband and god in order to create children. In contrast, barrenness, sub-fecundity, meaning less than normal fertile, and child death are related to ancestors or gods punishment due to current relationships with in-law.

The investigation of the cultural context of high fertility by Caldwell & Caldwell (1987) has shown a firmly embedded religious belief system. This religious belief system assigns importance to high fertility due to a spiritual belief that emphasizes the power of successive generations, even in afterlife. Children are perceived as identifier of ancestors who are reborn in their form. Thus, small families limit the opportunities to rebirth and might lead finally to extinction. Instead, high fertility and surviving children are equated with “[...] joy, the right life, divine approval, and approbation by both living and dead ancestors” (Caldwell & Caldwell, 1987, p.416). Couples with a small number of children are even equated with sin and disapproval of the ancestors. Filial piety comprises, besides social and religious duties, also respect and obedience.

Nevertheless, reproduction behavior in Africa consists of potentially long postpartum female sexual abstinence, meaning up to three years after birth (Caldwell & Caldwell, 1987). This is due to the fact that closely spaced births are a source of child mortality with respect to the older offspring. In addition, breast milk is perceived unclean, and thus not suitable for the nursling. As a consequence, closely spaced offspring was more likely to be fostered out (Vandermeersch, 2002).

In West Africa fostering is very common. For instance, studies by Isiugo-Abanihe (1985), Caldwell & Caldwell (1987), Vandermeersch (2002) and Akresh (2009) show that children do not reside in the identical household as their biological parents. Estimates assume that one-third of children in West Africa have identical rights of accommodation and assistance as biological children. In Ghanaian household data in 1971 detected Isiugo-Abanihe (1985) that about 20% of all offspring up to 10 years was foster children. The linkage of biological parenthood and number of descendants undermines the discussion of fertility behavior according to the cost and value of children. Child fosterage

[...] is likely to influence decisions concerning childbearing, child care and rearing, the education of children, and the labor force participation of both children and mothers. Where fostering is practiced widely, as in West Africa, such effects may be significant in determining overall patterns of fertility and child mortality (Isiugo-Abanihe 1985, p.53).

Vandermeersch (2002) identifies several motivations for in- and out-foster practices. These include alliance, apprenticeship and educational attainment opportunities, among others. Prosperous parents support biological and non-biological children. Similarly, support successful siblings the less successful. As an important result of fostering practices mentions Vandermeersch (2002) that male reproduction behavior cannot be directly connected to financial expenses. In addition, while a nuclear family in the Western world is considered to be a major pillar regarding emotion and spending, this does not apply to SSA.

Akresh (2009) investigates 486 households in 15 randomly selected rural villages in Burkina Faso with regard to their fostering practices. Based on self-collected household data, he examines the relationship between shocks to household income, child gender imbalances, location from primary school and fostering behavior, that is whether households fostering in or out. The results by Akresh (2009) indicate that negative income shocks are associated with sending households, while receiving households show (small) positive income shocks (measured based on current income above average household income). This is in accordance with the facts emerging in Vandermeersch (2002). Interestingly, with regard to gender imbalances the data used by Akresh (2009) indicates that receiving households have a larger likelihood towards identical gender distributions among their offspring. Instead, hardly surprising is the fact that sending households are more distant from schools than receiving households (2.09 km and 1.58 km, respectively). Nevertheless, the dynamics of developments over time remain unexplored. Do fostering practices have an impact on persistent high fertility, and if so, to what extent? Despite the potential interrelationship of

fostering and fertility, it seems highly challenging to draw a precise line where fostering begins and ends. This might be due to the involved compositional and temporarily factors.

Caldwell & Caldwell (1976) and Romaniuk (2011) identify kinship pressure as a further factor for high fertility patterns. With empirical results from Nigeria Caldwell & Caldwell (1976) show that the limitation of family size was regarded as irresponsible by relatives since every risk of family limitation could potentially lead to its extinction, and thus needs to be averted. Reproduction or the anticipation of reproduction was a high commodity and barrenness absolutely undesirable, regardless of the cause. Kinship exerts pressure on couples in order to maintain high fertility, which in turn contributes to the continuation of the lineage. Sex preference was not an issue in this context.

In contrast to this indifference of sex preference argues Sonko,

“[...] especially sons, are considered a source of wealth and prestige. They provide labour on the farm, security to parents in old age and continue the family name and lineage at the death of the patriarch” (Sonko, 1994, p.403).

Nonetheless, in 1990, Caldwell & Caldwell illustrate the importance of females which “[...] are important in the African social system not only because they bear children but also they do most of the agricultural work” (Caldwell & Caldwell, 1990, p.2).

Persisting high fertility could be encouraged due to different preferences among spouses regarding their number of desired children. Bankole & Audam (2011) investigate survey data from 24 countries between 2003 and 2009. The authors conclude that in nearly two-third of the considered countries husbands preferred a larger family size compared to their spouses. Especially strong were the disparities with a difference of one (1) to five children in Western and Central Africa. In nine to 35% of partnerships disagreement occurred regarding another child. 18 to 39% of debates among couples focused on the moment of having the next child. For men holds true, the earlier the better. Bankole & Audam (2011) discovered that women seemed to be more familiar with benefits of abstinence and the associated spacing behavior. Since the results were based on ideal demand for children, they provide merely a rough indicator. In addition, the survey results might be distorted due to different perceptions between spouses, and thus produce inaccurate responses.

Several studies affirm early and universal marriages (Caldwell & Caldwell, 1987; Pebley & Mbugua, 1989; Sonko, 1994). Sophisticated systems were in place to facilitate remarriages if necessary, by which high fertility could be ensured. Maintained remarriage systems included

the levirate, meaning the brother of the deceased man was obliged to marry his brother's widow, and vice versa. In contrast, Romaniuk (2011) considered the levirate as a waning traditional practice. This circumstance was partly owed to diminishing kinship pressures. Nevertheless, corporate allegiance was continuously identified by Romaniuk (2011) as an important pillar related to marriage, and thus to child-bearing. Taking into account the studies' investigation time, it becomes obvious that changes in cultural factors certainly occur. If adhering to Romaniuk (2011), a constant TFR over time in Niger would indicate that at least the levirate does not seem to have strongly contributed to the persistence of high fertility.

A further form that supported universal marriage patterns was polygyny (Caldwell & Caldwell, 1987; Pebley & Mbugua, 1989; Sonko, 1994). That is, men were married with multiple wives at the same time. The levirate and polygyny ensure high numbers of children during the reproductive period. Pebley & Mbugua (1989) use data from the World Fertility Survey which indicated for southern West Africa and western Central Africa that 20 to 50% of husbands considered more than one woman as their wife. Less pronounced was the result for East and South Africa with about 15 to 30% of men categorized as polygynists. Probably an economic relationship can be established between income and the proportion of polygyny. Due to higher income, more disposable pecuniary resources allow to raise the number and amount of brideprices. However, with the help of a hazard model Pebley & Mbugua (1989) discovered that fertility behavior in polygyny based partnerships was not clearly understandable. While in Kenya and the Ivory Coast polygynous marriages showed significantly reduced fertility compared to monogamous wedlocks, the final number of children was subject to strong fluctuations and dependent on the age of the cowives. That is, in case the cowive was younger than the man, the number of children was higher in comparison to relationships in which the cowive was older than the man.

In a similar vein investigate Madhavan & Bledsoe (2001) the compound as a locus of fertility management. The authors argue that child-bearing and the number of final progeny was not only dependent on a female's own fertility status but also by that of co-resident women. After combining a cross-sectional survey with a multi-round survey that reported quantitative and qualitative information, the final sub-sample consisted of approximately 302 women and 179 husbands in the North Bank region in The Gambia. The conclusion of the study by Madhavan & Bledsoe (2001) was that females and males in rural Gambia negotiate their marital and fertility schedules within compounds. Thus, institutions in traditional high fertility regions might be less responsive in encouraging large progeny.

A further important determinant of fertility behavior is *child mortality*. While applying frailty models to DHS data for Ghana and Kenya, Gyimah (2002) discovered that infant death diminished the time window to the next birth. Ghanaian women experienced a reduced median time to the second birth from 36 months to 23 months if the first child died as infant. In addition, while those women with no infant death until the fourth birth conceived 1.7 more babies, no surviving children up to parity four led to six additional newborn. This is a massive difference of 4.3 children. Using data from the Living Standards Measurement Surveys (LSMS) for Côte d' Ivoire and Ghana, the estimates by Benefo and Schultz (1996) show that four to fifteen fewer child deaths contributed to a reduction of only one (1) birth. The study by Kazembe et al. (2012) indicated that for Rwanda, Senegal and Uganda large rural-urban differences exist with regard to child mortality. Simultaneously, families with four or more children experienced higher mortality hazard risks (HR = 4.18) in contrast to families with one (1) to three children (HR = 0.54). The authors used Census data and estimated their results with the help of a Cox regression model. In contrast, Locoh (1994) indicates studies that provide explanations why higher child survival did not generate the desire for smaller families. Firstly, fertility behavior adapts only if lower child mortality rates are perceived as enduring. Secondly, the continuous use of labor-intensive methods sustains demand for children. While animal traction increases the cultivation of land, the weeding rises at the same time – a task typically assigned to women. To save their personal resources, mothers take with them their offspring to the fields for weeding.

Family planning programs are regarded as solution to diminish family size. However, such programs encounter resistance due to the fact that fertility control is in opposition to religious and cultural values (Caldwell & Caldwell, 1990). Consequently, Caldwell & Caldwell (1990) find that recruiting ambitious project workers represents a challenge. In addition, innovative contraception was perceived as unnatural since reproduction goes back deep to African roots. Contraception does not rule out the existence of sequelae, such as barrenness, sickness or child death. According to Caldwell & Caldwell (1990), downright fears prevail regarding sterilization and contraception among women. The confrontation of Africans with modern contraceptive methods resulted often in rejection arguing that already sufficient techniques exist. While modern contraceptive practices in SSA ranked among the lowest in a global perspective, the effectiveness of traditional contraception remains doubtful. Nevertheless, unmet demand might have hampered the transition from traditional, that is withdrawal or periodic abstinence, to *modern* contraception. For instance, Romaniuk (2011) confirmed for the Democratic Republic of the Congo a low use of modern contraceptive techniques. Surprisingly, despite a decreasing application of traditional contraception methods from 27% (2001) to 15% (2007), no increase among *modern contraceptives* was

noticed. However, Cohen (1998) depicts for Uganda and Mali lower fertility levels which are driven by later marriage and the adoption of *modern contraceptives*. In addition, he indicates that *modern contraceptives* are used to space and not to stop child-bearing altogether.

Family planning is frequently related to demand issues. Regarding Niger, Potts et al. (2011) indicate that despite a low reported demand for family planning demand, only 42% are de facto satisfied. According to the World Bank (2010), small to modest change could be achieved in high fertility countries if unmet need would be tackled. This result derives from unspecified demographic survey data. Furthermore, Potts et al. (2011) assign the low age at marriage an outstanding role regarding the persistence of high fertility rates. In some parts of Niger mean age at marriage is less than 14 years. While simulating the event that age at first birth increased by five years, Potts et al. found that prospective population growth in Niger would decrease by 15 to 20%. Nevertheless, marriage delays and the subsequent consequences for child-bearing behavior are related to long time intervals. Whether there is a danger of compensational affects towards extramarital child-bearing is not discussed by the authors.

There are fairly numerous studies that investigate the link between fertility behavior and education (e.g. Martin, 1995; Lloyd & Blanc, 1996; Bauer et al., 2007). Repeatedly studies concluded that the relationship towards reproduction behavior in a least development context with low illiterate rates was not profound. However, the education-fertility link was more pronounced as soon as societies extended educational attainment opportunities and economic growth levels. Moreover, country-specific socio-economic standard and social as well as cultural structures were important in order to assess fertility transition correctly. While acquiring literacy skills, individuals could gain access to information on contraceptive use, other health related issues or encountered attitudes, opinions and values which were in contrast to family and traditional norms or practices. In Uganda, Bauer et al. (2007) discovered that the desired number of children increased due to a fear of diseases and more intense integration into traditional clan institutions. Interestingly, education diminished the effects noticeable due to enhanced individual health prevention as well as declining clan influence. Educational attainment suggests to open the path towards economic or employment participation outside the household, and thus empowers women.

Methodological issues in the previously presented literature must be borne in mind. For instance, cross-sectional census data cannot take into account temporality. Thus, causality of the observed associations cannot be established. Moreover, data quality is prone to missing information and recalls are subject to distortions by the respondent. The usage of

complex questionnaires might lead to inconsistent responses. A further issue is the report of important correlates concerning the risk of child-bearing, for example amenorrhea, only for younger cohorts. Consequently, indicators for births among older cohorts might be biased.

Previous research on fertility behavior in SSA could be divided into two major areas. On the one hand, traditional based on polygyny or postnatal abstinence and on the other, modern options, such as family planning, reproductive health or education. Both, tradition and modernity embody the importance of child-bearing. For example, universal marriage and religious pressure ensure high fertility. At the same time, child mortality remains high and the extent of efficient contraception relatively low.

2.3 Theoretical Background

A widely used approach regarding the demand of children is microeconomic household theory. The explanation of this theory draws heavily on Todaro & Smith (2003). Economic principles determine the number of offspring within an utility function. In accordance to the existing tastes and preferences for a certain amount of goods, satisfaction is maximized within the limits of income and the relative prices of goods. However, in the household theory of fertility, children are a special good, meaning investment good. As a result, fertility decision making is responsive to other demanded goods. Taking into consideration common income as well as substitution effects, under the ceteris paribus rule a situation emerges where the desired amount of children is directly dependent on the household income, inversely to the price of children and the intensity of tastes for other goods relative to children. In underdeveloped countries this direct relationship might not be applicable, since depending on the intensity in the demand for children in relation to remaining consumer goods as well as the sources of rising income.

As an illustration of the above mentioned shall serve the following model:

$$C_d = f(Y, P_c, P_x, t_x), x = 1, \dots, n \quad (1)$$

In the model C_d represents the demand of surviving children determined by Y , the household income, P_c , the “net” price of children, that is the difference between anticipated costs and benefits, P_x , the prices of all remaining goods and t_x , the tastes for goods proportional to children. When assuming a utility maximization of income constrained individuals and rational choice, expectations are:

$\partial C_d / \partial Y > 0$ The higher the household income, the greater the demand for children.

$\partial C_d / \partial P_c < 0$ The higher the net price of children, the lower the quantity demanded.

$\partial C_d / \partial P_x > 0$ The higher the price of all other goods relative to children, the greater the

quantity of children demanded.

$\partial C_d / \partial t_x < 0$ The greater the strength of tastes for goods relative to children, the fewer children demanded.

The diagram in Figure 1, provides the number of desired and surviving children on the horizontal axis and, G_p , total quantity of goods consumed by the parents on the vertical axis. Illustrated is the level of satisfaction with regard to all conceivable combinations of commodities and children. All depicted indifference curves display an identical amount of satisfaction. The further the combination of goods and children on the indifference curve is distant from the origin, the higher the degree of satisfaction. Out of a theoretically infinite set of indifference curves merely four are shown. Budget constraint lines display the potential combinations of commodity-children combinations affordable for the household. That is, while for the budget constraint ab commodity-children combinations below the line are financially accessible, in contrast, those above are not. The slope ab embodies household income prospects and relative prices of children and goods.

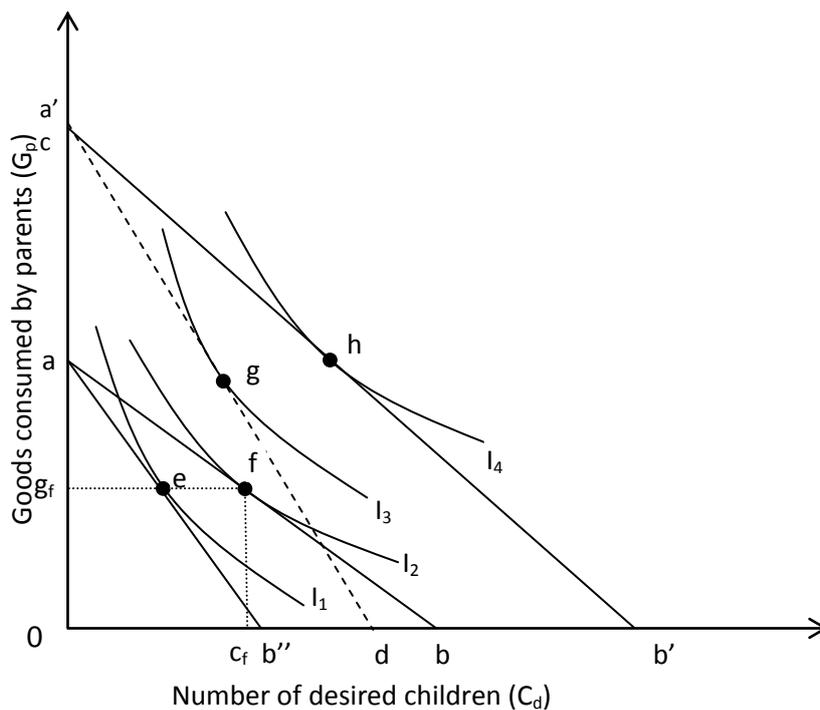


Figure 1: Microeconomic theory of fertility (Todaro & Smith, 2003, p.282)

On the one side, Todaro & Smith (2003) argue that the demand for children is determined by the fact that the combination of goods and children is achievable. On the other side, that combination is chosen which maximizes the level of satisfaction with regard to family based preferences. If the line ab represents the budget restraint, then the optimal combination is depicted by point f . This tangency point will lead to the accordingly demanded number of

children (c_f) and goods (g_f). The scenario of an increasing household income would entail a parallel shift outwards to budget constraint line $a'b'$ and tangency point h . That is, a higher consumption of both, commodities and children is feasible, and accordingly more satisfaction. However, here applies an additional condition, namely, that children are normal goods. That is, demand for children rises with increasing income. In case the price (opportunity cost) of children increases in proportion to other goods, households substitute goods for children. The lower indifference curve ab'' indicates an increase in the relative price of children provided that income and tastes remain constant. As a result of simultaneously increasing household income and net child price, an outward shift combined with a downward rotation of the budget constraint line (cd) takes place. The new utility maximization leads to a decreasing number of children per family (comparing the tangency point g and f). As a conclusion follows that higher living standards in low-income families in combination with raising relative prices of children give incentives that the household diminishes their offspring in order to enhance child's welfare.

According to Todaro & Smith (2003), several particularities apply regarding the demand for children in developing countries. As demonstrated above, fertility preferences play an important role in the household demand for surviving children. In regions with high *child mortality* rates, couples might have more children than actually desired, anticipating the high *child mortality*. In addition, compared to developed regions, the role of children in poor societies is tightly intertwined with returns from child labor or upward intergenerational financial streams in old age, by which offspring can be regarded as economic investment. Extremely difficult appears the unification of economic household theory concerning the demand for children with pronounced intrinsic cultural, psychological or religious mechanisms that shape family sizes.

An important question is whether all children can be considered as normal consumption goods whose demand is almost unchanged by fluctuations in relative prices. The illustration of economic mechanisms in fertility theory for developing countries by Todaro & Smith (2003) is expected to be applicable for additional or marginal offspring. The demand for additional children is subject to a calculation of private benefits against private costs. While income from child labor and old age support are distinctive benefits, two predominant expense factors exist. On the one hand, opportunity cost of the mother's time. On the other hand, opportunity cost and actual expenses of children's education. That is, a trade-off between high and low educated children with earnings expectations accordingly. Increasing the price or cost of children should result in a situation which induces parents to demand fewer extra children. Potential reasons for such an increase might be that educational or employment

opportunities for females improve, laws prohibit child labor or the existence of public old age pension. Fewer extra children could instead be substituted via quality for quantity. As a consequence, an incentive for limited family sizes could be to raise the price or cost of children.

In comparison to Todaro & Smith's (2003) microeconomic theory, Easterlin (1983) detaches from an entirely economic perspective. He considers the complex phenomenon of fertility as interdisciplinary. In his view, different academic disciplines, such as public health or psychology contribute towards the framework for the study of fertility determinants in Figure 2.

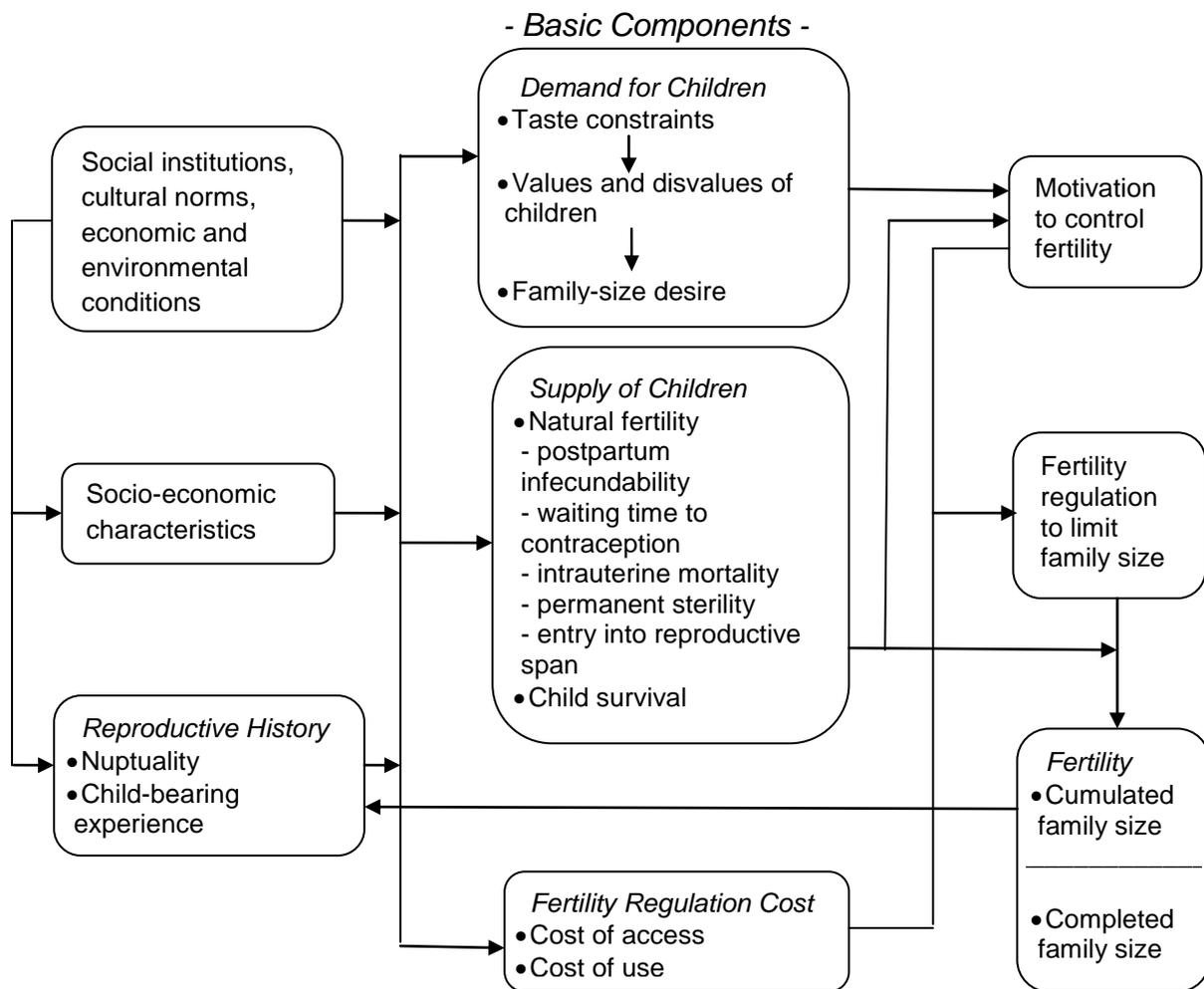


Figure 2: Framework of fertility determination by Easterlin (1983, p.9)

Three factors dominate Easterlin's framework. Firstly, the demand for children while neglecting the supply and family size limitation. Apart from supply and fertility regulation costs, demand is coined by the interrelationship between tastes and constraints. Secondly, the supply of children that a couple would have without attempts for intentional limitation.

However, noticing deliberate family size limitation seems troublesome. Thirdly, cost of fertility regulation. Regulation is either the means for effecting choices or a factor in choice.

Within the framework the factors' relative levels are decisive in order to determine if and how couples control their fertility. For instance, exceeds the potential supply of children the desired demand, then increases the expected motivation to control fertility. The motivation to control might depend on the motivational strength and the costs for fertility regulation.

Three blocks influence the basic components in Easterlin's (1983) framework. In the first block dominate classic economic analysis variables, such as education, female employment and place of residence, among others. The second block comprises the reproductive history in form of nuptiality and child-bearing experience. This concerns variables, such as age of entry into sexual union or dissolution of a sexual union by separation, divorce or death. The final block considers society and culture. This includes the price structure which might affect the demand for offspring or government policies that diminish fertility regulation costs.

Several assumptions underlie Easterlin's fertility framework. Decision making takes places at the level of the couple or household. Yet, the assumption deviates from previous research. For instance, indicated Caldwell & Caldwell (1987) and Romaniuk (2011) that kinship pressure on fertility behavior from beyond the household seems not uncommon in SSA. A further assumption is that the framework considers only surviving children. However, a clear temporal limitation for when children are counted as survivors is not provided. Additional caveats of the model include the choice between contraception and abortion as well as contraceptive methods. Plus, the relative importance of fixed costs and those costs that vary with the amount of births averted. Obviously, effects exist due to changes in demand and supply on method choice as well as the timing of the use of different methods.

Carlsson (1966) presents two types of fertility transition theory. Before elaborating more on the innovation and the adjustment approach, Carlsson enumerates ideas which are connected to the fertility decline. Those ideas comprise the process of industrialization, agricultural evaporation, educational expansion, changing status of women in society as well as secularization and a general modernization of humanity. The concept of innovation theory reflects on the more intense application of birth control methods. In a subsequent step the theory describes two essential 'trickle down' effects in the diffusion of knowledge about contraception. Firstly, on the regional level where a spread of information takes place from metropolitan, via urban to rural places. Secondly, on the class level occur differentials in the

acceptance of birth control. He indicates that manual and rural workers lag behind the middle-class.

According to Carlsson (1966), adjustment theory embodies a structural concept which in contrast to innovation theory does not consider birth control as new achievement of humanity. Instead, it seems that a status quo exists in large parts of society concerning birth control. Fertility reductions demonstrate merely an adjustment towards 'modern' fertility and thus a different equilibrium. In adjustment theory, control is exercised by human motivation based on individual desires and values. Those desires and values might be shaped by knowledge about infant and child mortality received from governments and organizations via, for example, newspapers as well as through individual information mechanisms in form of friends and neighbors. However, Carlsson (1966) concludes that neither solely regional nor merely class differences in fertility behavior can be accepted without certain additional considerations, and more importantly that the entanglement of both is key for further understanding of fertility dynamics.

The three presented theories affect the empirical model as follows: the microeconomic household model is particularly important to understand the mechanisms at play for the interrelationship between household durables and the number of children. The theory suggests a clear answer to the question what occurs, for instance, to the number of *children ever born*, if the price of household durables decreases. In addition, the important entanglement between investments in children's education and the consequences for family size is recognizable. The fertility framework as second theory affects the empirical model with special emphasis on the supply of children and fertility regulation. In contrast to the also indicated demand of children, both dimensions are quantifiable in order to report for the impact on the number of *children ever born*. Finally, innovation and adjustment processes as explanation for the fertility decline influence the empirical model directly through the consideration of contraceptives (innovation) or indirectly due to individual desires and values (adjustment). Moreover, the latter are expected to be shaped by child death experiences. Simultaneously, the increasing consumption of, for instance, *household durables* initiate new values and desires that are in contradiction with large family sizes.

2.4 Research Hypotheses

The research hypotheses were derived from the previously presented literature review as well as from the conveyed theoretical underpinnings regarding fertility dynamics. The empirical analysis is guided by three research hypotheses:

Hypothesis 1: Child mortality influences the number of *children ever born*, particularly among old women.

As pointed out above, for instance Gyimah (2002) or Kazembe et al. (2012) showed that *child mortality* is a decisive factor for the number of received children over time. The assumption that this link is more pronounced among old women relates to Carlsson's (1966) adjustment theory. In this context, changes in human motivation translate more profoundly into increased fertility among old women due to the fact that *child mortality* decline is not perceived as reversible. In contrast, young women may perceive *child mortality* as irreversible.

Hypothesis 2: The existence of household durables diminished the number of *children ever born*, especially among young women.

Todaro & Smith (2003) illustrate in the microeconomic theory of fertility, how the increased demand for *household durables* interrelates with the household budget and the subsequently desired number of *children ever born*. The assumption that particularly young women experience a drop in fertility is due to the expectation of a more facile access and affordability of *household durables* in contrast to older females.

Hypothesis 3: Education among respondents is negatively correlated with child-bearing, especially among young women.

Education may serve as a medium for the dispersion of knowledge about health and family issues, among others. Therefore, females with educational attainment have in all probability better information on contraceptives and on the prevention of diseases that affect *child mortality*. The school environment enhances the chance to establish social networks, which in turn might facilitate the prospective access or exchange of resources and knowledge. Thus, successful social relationships due to school participation could be transferred to the offspring who in turn follows the parental example. In addition, skills acquired in school, such as reading and calculating, could promote economic participation. Due to labor market participation, females could gain more self-esteem, and thus obtain a better negotiation position regarding the number of *children ever born*.

3 Data

Initially, chapter 3 presents core information about the data source and issues of source criticism. Next, the sample distributions of selected descriptive variable statistics are assessed and distinctive features indicated.

3.1 Source Material

Measure national DHS data served as single source for the present analysis. Besides the spatial proximity, the availability of current individual datasets from the DHS was one (1) of the main criteria for the selection of Niger and Senegal as representative states in SSA.

In general, Measure DHS conducts projects since 1984 in over 90 developing countries all over the world (Measure DHS, 2013). According to Measure DHS (2013) the main concerns comprise the monitoring of important indicators on fertility and family planning, among others. The objective of monitoring is to understand global trends in health and population issues. Especially valuable is the gain of information for policymakers and planners who derive in this way knowledge about the progress of developmental programs.

DHS data collection underlies certain characteristics. Sample sizes between 5,000 and 30,000 households enable nationally representative surveys (Measure DHS, 2013). The eligible survey population comprises women aged 15-49 and men aged 15-54. Standard model questionnaires are used in order to guarantee data comparability across countries. According to Measure DHS (2013), the three core questionnaires (household, female, and male) are subject to ongoing review in order to allow for modifications. Besides the core questionnaire, varying standardized modules exist. These try to gain special information, for instance about sterilization experience. In addition, core questionnaires differ between countries with relatively high and low contraceptive use, whereby the questionnaire of the latter contains considerably more information on family planning. Regardless of contraceptive practices, the questionnaires for women include sections such as, Knowledge and Use of Contraceptive Methods, or Fertility Preferences, among others. Monitored countries have the chance to add relevant questions of particular national interest.

Measure DHS (2013) states that the questionnaires have altered substantially between the different cross-sections, and various recode definitions are available for each DHS survey. Variables that occur in several of the phases keep the same meaning, and merely if

questions are omitted from one (1) survey phase to the next, variables are not reused. Moreover, variables will not be present in the recode definition of the phase where they became dropped. In cases where new questions were added to the core questionnaire a new variable will appear in the recode definition.

Fink (2003) names essential points of source criticism, such as reliability and validity. Reliability is reflected in consistently measuring survey instruments in comparable situations. Due to imperfect measures in practice, dealing with measurement error is an absolutely essential issue. Reasons for measurement error are commonly linked to the survey instrument which is in the present study the individual women's questionnaire. Either the latter is too difficult to understand for the study participants or the administration might lack precision by careless project workers. Problems of understanding the questions might occur in case the required reading level is too sophisticated, for instance if teenage mothers are the potential respondents. In addition, the surveyor may mark answers wrongly on the questionnaire or transfers received responses falsely into electronic data processing, by which reliability suffers remarkable losses.

Validity translates into that the "answers correspond to what they are intended to measure" (Fowler, 1999, p.69). Due to four dominant error sources respondents may report less accurate answers (Fowler, 1999). Firstly, they do not understand the question at all or the direction is misinterpreted. Respondents might have a different perception of what the question asks explicitly for. Thus, ambiguous terms could generate distorted data since the respondents are rather unlikely to ask for clarification if they have trouble to understand the meaning of the question properly. Secondly, respondents do not know how to answer. Since respondents perceive questions about themselves that they are unable to answer, the question design might be problematic. Thirdly, respondents are unable to recall the answer even so they do know it. Instead of recalling information, frequently respondents do estimate the answer. For instance, examinees cannot recall the expenses of medical care that is disbursed by the insurance. Finally, they might not want to respond to the question in the given interview context. Certain socially undesired facts or events, like abortion, are avoided to report precisely. Furthermore, underreporting is common in context with alcohol consumption since difficulties in memory or social norms create negative concerns. Illegal or very embarrassing information might also be complicated to obtain.

Source criticism might be particularly relevant for fertility preferences since respondents could provide misleading information in a more generalizable manner. In the final report for the DHS survey in Nigeria (2008) is mentioned that answers partially consist of uninformed,

ephemeral opinions without any substantial conviction. Countries with low contraceptive prevalence, that is low consciousness of reproductive alternatives, should be more affected by misleading information than countries with high contraceptive prevalence (DHS Nigeria, 2008). Moreover, the report indicates that subliminal social pressures from close family members could exert influence on the provided information, for example regarding the number of desired children.

Data quality problems are a potential threat for discrepancies across multiple surveys, as used in this thesis. For instance, Schoumaker (2009) points out that “[...] Burkina Faso, Niger and Mali are typical countries with severe omissions and displacements of births backward in time [...]” (Schoumaker, 2009, p.17). As a result, fertility underestimation occurs directly before the survey (Schoumaker, 2009). Omissions of recent births and the displacement of births arise since interviewers try to circumvent the long health module in the DHS. Sample composition problems could introduce a bias, for instance due to the underrepresentation of educated females in a survey. Consequently, fertility levels calculated from that survey are probably overestimated. In addition, reliability in fertility trends is absent if over- or underrepresentation differs across consecutive surveys (Schoumaker, 2009). An empirical example provided by Schoumaker (2009) concerns the overrepresentation of educated and not married Nigerian females. Their number was larger in the 1999 survey in comparison to the 1990 and 2003 surveys, by which fertility is underestimated in 1999. A suggested remedy might be to reweight the cases in the 1999 survey so that educated and unmarried females are equally distributed across the consecutive surveys.

Problems with DHS data quality in Nigeria are also reported by Ibisomi (2007). He noticed that within the 1999 household and individual sample a relatively large number of women is reported as being aged 9. Just as Schoumaker (2009) above, Ibisomi (2007) assumes that surveyors deliberately pushed females aged 10, 11, 12 out of the age range for an individual interview. The rationale behind is that only women aged 10 to 49 years were considered for an individual interview in the survey. In addition, serious age heaping appeared on ages ending in 0 and 5 as well as to a lesser extent in terminal digits of 2 and 8.

With regard to validity, two important concerns have been recognized while working with DHS data for Niger and Senegal. Firstly, the recoding practices into new variables. For example, *literacy* was recoded from three into six possible categories in the most recent survey, 2005 in Senegal and 2006 in Niger. Initially, the analysis might appear refined and more precise due to a larger number of response categories. However, the higher number of categories could extend the difficulties in order to distinguish among the answer options.

Secondly, certain variable categories experienced a dramatic rise or fall of their frequency between the cross-sections. For instance, the variable *relationship to household head* included the category 'Other relative'. In the survey for Senegal 1992-93 and 1997 the frequency of occurrence was 1,162 and 1,595, respectively. However, in 2005 the category 'Other relative' drops dramatically to merely 134 cases. This is especially remarkable since the total number of cases for this variable more than doubles between the surveys 1992-93 and 2005. A possible consequence of a rise or fall in the frequency of occurrence is that cases might be redistributed between the variable categories, by which the entire analysis across multiple cross-sections might be distorted.

In sum, this section of the thesis provided rough information on the construction of DHS samples. Methodological issues like recoding practices between multiple cross-sections were pointed out. Besides a general discussion of reliability and validity, empirical caveats in DHS data for Nigeria were displayed. Finally, reliability and validity issues within the employed DHS data were illustrated.

3.2 Sample Information

The samples have the following characteristics. Information is obtained from the individual female DHS questionnaire. Three cross-sections are investigated for each country. The years for Niger are 1992, 1998 and 2006. Senegal is represented by the years 1992-93, 1997 and 2005. Obviously, the dates are not identical. The maximum inter-country difference comprises one (1) year. However, this should not threaten the intended inter-country comparison since the cross-sectional construction of DHS data is based on the previous five years, meaning 1992 reports for the period 1987 until 1992. Thus, the inter-country data overlaps to a large extent.

Table 2 reports the associated response rates for the individual women questionnaires in total as well as in urban and rural rates. Response rates have an impact on data quality. Individuals who completed their questionnaires might be different from those who did not. However, Table 2 reveals quite high response rates (greater than 95%) for both countries considering all three surveys. The lowest response rate (93.5%) displays the total and rural survey 1997 for Senegal and the highest response rate yields the urban survey for Niger in 1998.

Table 2: Response rates individual female questionnaire from Attama et al.,1998; Kourguéni et al.,1993; INS, 2007 and Ndiaye et al.,1994, 1997, 2006.

	Niger	Senegal
1992 (1992-93)	96.3/96.5/96.2	95.0/95.5/94.7
1998 (1997)	96.4/97.2/96.0	93.5/93.7/93.5
2006 (2005)	95.6/94.8/96.1	93.7/93.5/93.8

Notes: Table cells for Niger & Senegal report total/urban/rural rates in %

Descriptive statistics are assessed below in order to convey an impression of the distribution of the variables in the samples. Appendix 3 summarizes selected descriptive statistics of the sample variables. Reported parameters include the number of observations, the mean, the standard deviation as well as the minimum and maximum. *Children ever born* to women aged 23 to 45 years represents the dependent variable. Among the independent variables are *household durables*, *child death*, *modern contraception*, *respondent's education and partner's education*. The independently pooled cross samples contain additionally year dummies for 1998 and 2006 in Niger as well as 1997 and 2005 for Senegal. Year dummies are methodological necessities that allow the intercept to differ between the periods and the baseline year. The latter is 1992 for Niger and 1992-1993 for Senegal.

Intra- and inter-country similarities and differences in the variable distributions of fertility are assessed subsequently. An intra-country sample comparison for Niger shows the expected continuity for *children ever born* to women aged 23 to 45 years. In contrast, Senegal indicates a continuous decrease in the variable *children ever born* over cross-sections. This affirms the UN data in that there are increasingly diverging inter-country fertility patterns between these two countries (see appendix 1). However, the literature is ambiguous with regard to the fertility development in Senegal. While Shapiro & Gebreselassie (2008) indicate an early-transition stall, confirms Schoumaker (2009) a decreasing fertility pattern over time. The reason behind this is that Shapiro & Gebreselassie, apart from working with DHS surveys from 1992, 1997 and 2005, additionally use estimates from a DHS Final Paper in 1999. Even in case of an early-transition stall in Senegal, the present analysis can yield fruitful results without including those data. This is due to the nature of the applied samples which reflect the decline in fertility, and thus allow the interpretation of potential factors for reductions in fertility.

Subsequently, the mean value distributions among the applied variables are assessed. Particular attention is paid to major similarities and differences between Niger and Senegal.

Modern Contraception use increases for both countries over time. However, particularly in the most recent survey in Niger the mean value extends more profoundly in comparison to Senegal. While the initial mean value is rather similar between the two developing countries, the last cross-section differs by 0.08.

Child Death occurrence decreases among both countries across time. While this reduction is more pronounced in Senegal, the mean value in the first survey is 0.14 higher in Niger.

Household Durables mean value is stagnating over time in Niger. Instead, increases the mean value in Senegal over time, especially for the most recent cross-section. In the latest survey the mean value shows a difference of 0.31 between both countries.

Respondent's Education increases parallel for both countries. In the last examined survey Senegal's mean value differs by 0.12 from Niger's final value.

Partner's Education experiences an increase in Niger and Senegal. The mean value differs by about 0.05 almost equally for the first and the last survey. In a comparison between male and female education over time in both countries, the gap in educational attainment enlarges in Senegal, but decreases in Niger.

Modern Contraception Among Young Women is almost identically distributed in an inter-country comparison of the most recent survey. However, Senegal started from a lower initial level in contrast to Niger, and increased then gradually.

Child Death Among Young Women decreased in both countries over time. However, at all times the level is lower among young females in Senegal. In the last cross-section the occurrence among Senegalese women is nearly half that of those from Niger, 0.115 and 0.200 respectively.

Household Durables Among Young Women are distributed similarly throughout the cross-sections for both countries. While recovering in the final sample, the survey in-between yields always a decline in contrast to the first cross-section. The divergence in mean values comprises in the final cross-section 0.16.

Educated Among Young Women displays a rise among the share in both countries. This surge is more pronounced in Senegal. Interestingly, the share in the most recent survey in Niger still lies slightly below the proportion of the first survey in Senegal.

Partner's Education Among Young Women is with mean values between 0.075 and 0.08 equally distributed in the two initial surveys for both countries. However, the growth in the last survey leads to a final gap of 20%.

Finally, some notes regarding the number of observations. In general, the share of observations among the different variables increases between the cross-sections. However, the number of observations rises more intensively for Senegal. Consequently, the independently pooled cross-section dataset is decisively larger for Senegal than for Niger.

To sum up, this part of the thesis provided information on the used samples. The subsequent provision of response rates demonstrated relatively high representativeness over all surveys. Moreover, descriptive statistics for the variables were shown. This included an intra- and inter-country mean value comparison of the used variables for both countries. Major differences across the multiple cross-section variable distributions occurred for *household durables*, *respondent's education* as well as for the interaction term reporting *child death times young*.

4 Methodology

Chapter 4 provides information on the utilized multivariate model. Besides, it specifies and motivates the used socio-economic variables before introducing them into the econometric equations.

4.1 Statistical Approach

In order to investigate persistent high fertility in Niger, year-by-year multivariate linear regressions were applied. A further approach utilized independently pooled cross-sectional regressions.

Multivariate linear regressions seem appropriate for the aim of the study. Like other conceivable methods, there are attractive and less attractive features related to this method. A positive feature is the combination of several independent variables in order to generate optimal predictions of the dependent variable (Allison, 1999). In addition, root causal analysis is possible due to the decomposition of effects into explanatory variables and explained variable. As a result, the specific contribution of each explanatory variable is interpretable.

The applied multivariate regression will be based on a linear equation like the following form

$$y = a + b_1x_1 + b_2x_2 \quad (1)$$

In the equation (1) above, y represents the explained variable. The intercept, that is, the value if all explanatory variables are zero, is indicated by a , while $b_1/2$ display the slope coefficients, that is the impact value of $x_1/2$ on y , all other things kept equal or *ceteris paribus* (Allison, 1999).

Without a doubt, disadvantageous features are present in OLS regressions as well. A predominant critical issue is endogeneity due to simultaneity, omitted variables or measurement error (Allison, 1999). Particularly the latter might be of concern on account of reporting or coding errors during the data collection. As a result, the OLS estimator is biased and presents a threat to internal validity.

A further way to apply the multivariate method of analysis is to pool independent cross-section survey data. According to Wooldridge (2004), this method has the advantage to increase sample sizes. Consequently, estimators become more precise and have more powerful test statistics. An important assumption of pooling cross-sections is that dependent

and some of the independent variables have a constant relationship over time. However, in order to consider potentially different distributions in the population over time, the intercept is allowed to differ between periods, frequently applying years. In practical terms, dummy variables are introduced for all considered cross-sections, except the first cross-section which serves as baseline or base year. The year dummies' purpose is to account for aggregate changes over time. A further important issue is that pooled cross-sections over time do not allow for replicability, a major contrast to panel data. If units occur in multiple time periods their reappearance is considered as coincidental and ignored (Wooldridge, 2004).

As seen in Green et al. (2001), the pooled cross-sectional model takes the form

$$Y_{it} = \alpha + \beta_1 X_{1it} + \beta_2 X_{2it} + \dots + \beta_K X_{Kit} + u_{it} \quad (2)$$

The dependent variable in (2) is a function of K right-hand-side variables which change across time and space. While subscript i stands for one (1) of the N cross-sectional units, the subscript t refers to one (1) of the T time points. The clue of the model is that, in contrast to single cross-sectional analysis, all intercepts are identical.

Each multiple regression is followed by two post-estimation tests. In order to specify heterogeneity, the Breusch-Pagan test is applied. Heteroskedasticity occurs in case the square of the error is related to one (1) or several independent variables. The null hypothesis assumes homoskedasticity and is

$$H_0: \delta_1 = \delta_2 = \dots = \delta_k = 0 \quad (3)$$

The associated test statistic is

$$LM = n * R_u^2 \quad (4)$$

In (4), sample size is multiplied with R-squared from the estimated regression (Wooldridge, 2004).

The second post-estimation test is the variance inflation factor (VIF). With the help of the latter, collinearity problems can be identified (Rabe-Hesketh & Everitt, 2004). Collinearity leads to large estimator standard errors that introduce a bias in the t-tests. Consequently, parameter estimates remain insignificant. Such results occur despite significant explanatory power within the model. The VIF estimator is

$$VIF (x_k) = \frac{1}{1 - R_k^2} \quad (5)$$

In (5), VIF (x_k) depicts the variance inflation factor for the independent variable x_k , and R_k^2 indicates the square value of the multiple correlation coefficients. The latter is obtained from the regression of x_k on the remaining independent variables. As a rule of thumb, values larger than 10 indicate collinearity. Likewise, VIF mean values larger than one (1) indicate collinearity.

In sum, this section presented the applied multiple regression specification and the underlying OLS method. Pros and cons of this estimation technique were illustrated. Besides the cross-sectional procedure, independently pooled cross-section analysis was presented. Finally, two applied post estimation tests, the Breusch-Pagan test and the VIF, were depicted.

4.2 Variable Definitions

In order to select the utilized variables, the section on previous research (2.2) provided guidance. Table 3 lists all employed variables with their associated definition. An age-specific analysis is chosen in order to assess the changes in fertility determinants over time within the particular age groups. The female study population is limited to the ages 23 to 45 years, since the largest share of variation in fertility occurs within this time frame. The estimation of the age-specific effects in fertility behavior uses dummy variables and interaction terms.

The estimation procedure differentiates fertility behavior among females aged 23 to 31 and 32 to 45 years. A comparative research strategy using the separation into young and old women has at least two reasons. Firstly, a large part of the empirical strategy uses the fact that fertility declined in Senegal. Obviously, fertility transition is a process in time. Logically, the contribution towards fertility decline has to be more profound among young than old women in the current case. Senegal would otherwise continuously indicate persistent high fertility patterns. Secondly and related to this, the independent variables are expected to vary over time in an inter- and intra-country perspective. The decomposition of effects into young and old females provides probably a much clearer picture about the underlying fertility patterns and drivers regarding the number of *children ever born*. Thus, due to the age-specific fertility decomposition, more precise statements about the patterns and drivers can be made. Apart from large variation in fertility, another decomposition criterion for the determination of the age intervals was the nearly equal distribution of observations among both groups.

Despite the importance in the literature, the information on foster children and the impact on fertility behavior were omitted from the analysis. This has two reasons. First, the variable is coded together in one (1) category with adopted children. Therefore, a clear identification of the impact of foster children on the number of *children ever born* is impossible. Second, the majority of cross-sections contain only a very low frequency of cases. Consequently, the statistical tests would be invalid.

Table 3: Variable definitions

Variable	Variable definition
Children ever born ¹	Children ever born alive to women aged 23-45; includes children who have died since birth; not included are stillborn, abortions or adopted children
Child death	Dummy child death up to age 10 to women aged 23-45 (reference category: no child death up to age 10 among women aged 23-45)
Household durables	Dummy if household possesses radio or television, or refrigerator among women aged 23-45 (reference category: no radio or television, or refrigerator among women aged 23-45)
Modern contraception	Dummy modern contraceptive method among women aged 23-45 (reference category: no modern contraception method among women aged 23-45)
Respondent's education ²	Dummy education among women aged 23-45 (reference category: no education among women aged 23-45)
Partner's education ²	Dummy education partner among women aged 23-45 (reference category: no education partner of women aged 23-45)
Child death times young	Interaction term for child death among women aged 23-31 (reference category: no child death among women aged 23-31)
Household durables times young	Interaction term if household possesses radio or television, or refrigerator among women aged 23-31 (reference category: no radio or television, or refrigerator among women aged 23-31)
Modern contraception times young	Interaction term modern contraceptive method among women aged 23-31 (reference category: no modern contraception method among women aged 23-31)
Respondent's education times young	Interaction term education among women aged 23-31 (reference category: no education among women aged 23-31)
Partner's education times young	Interaction term education partner among women aged 23-31 (reference category: no education partner among women aged 23-31)
Year 1997	Dummy year 1997 (reference category: year 1992-1993)
Year 1998	Dummy year 1998 (reference category: year 1992)
Year 2005	Dummy year 2005 (reference category: year 1992-1993)
Year 2006	Dummy year 2006 (reference category: year 1992)

Notes: 1) dependent variable

2) variable combines categories primary, secondary and higher educational attainment

As evident from Table 3, this study used predominantly qualitative variables (or dummies) in order to estimate the categorical effects in fertility levels. Dummy variables take value one (1) in case the specified category occurs, and value zero otherwise. In addition, Table 3 contains interaction terms. In general, interaction terms are independent variables which are derived from the product of two or more explanatory variables. In this study, all interaction terms are gained from the product of two dummy variables.

To sum up, this section included the definition of the dependent and independent variables. Furthermore, background information was provided on the construction of the dependent variable. Besides, reasons for the omission of the theoretically important variable *foster children* were presented. Finally, the construction of dummy variables and interaction terms was explained.

4.3 Variable Motivation

This part of the thesis provides background information on the finally selected variables for the analysis.

Educational attainment of the respondent seems to be a powerful determinant of fertility behavior. Education is associated with the onset of reproduction as well as knowledge about birth control practices. In addition, schooling can have an impact on child survival based on the enhanced understanding of the symptoms of potential illnesses and better access to social or health networks. Material circumstances and the quality of life in general might rise due to improved chances in market activities based on educational attainment. In turn, participation in market activities depends probably strongly on educational skills, such as calculating and writing.

Educational attainment of the respondent's partner could influence fertility via improved income channels, among others. On the one side, assuming the dominance of the male-breadwinner model in developing countries, men could be in a better negotiation position regarding the number of children. On the other side, missing education not only decreases negotiation skills, but could additionally limit economic activity, and thus income opportunities. As a consequence, children might be perceived as contributors to the household budget. Interestingly, Aurig (2012) finds with DHS data for the Philippines that

between 1993 and 2008 educational attainment was a significant contributor to the fertility decline. While downward for women, the impact by men showed an upward trend which finally even surpassed females. Therefore, it might be of interest to investigate the impact on fertility behavior in a SSA context.

Child death contributes to uncertainty. As a consequence, the hoarding phenomenon might appear. That is, progeny is stockpiled in advance, due to the insecurity which children provide appropriate support in the future (Ray, 1998). Thus, in all probability experiences with *child death* lead to insurance births that conserve high fertility levels.

Household durables can capture changes in economic development. Due to the used household items, the occurrence of *household durables* reports indirectly whether the household has access to electricity or not. Life without electricity undermines health, limits educational and economic opportunities, and thus might not contribute to poverty reductions. Instead, theoretical underpinnings suggest that higher living standards can decrease the number of progeny or vice versa. That is, a decline in fertility eventually provides a higher living standard. A reason for this could be that consumption patterns shift away from a large number of children, despite increasing household income as reflected in the microeconomic household theory in section 2.3.

Modern contraceptives are important with regard to at least two issues. Firstly, if used correctly *modern contraceptives* have a higher level of effectiveness in comparison to the two other contraceptive practices measured by the DHS. Apart from *modern contraceptives*, DHS reports traditional methods, that is periodic abstinence and withdrawal or folkloric methods which capture all other methods. Secondly, due to their effectiveness *modern contraceptives* are a relatively safe way to prevent high-level births. As a consequence, maternal and child mortality rates are likely to reduce. *Modern contraceptives* include intrauterine device (IUD), pill, male condom and injectable contraceptives.

The empirical analysis uses also interaction terms. These include: *respondent's education times young*, *partner's education times young*, *child death times young*, *household durables times young* and *modern contraception times young*. The purpose of the interaction terms is to capture the difference in slopes between young and old women. Differences in slopes are expected since, for example, *educational attainment* has not the same effect on fertility behavior across age groups. Interaction terms help to model this difference.

In conclusion, this part of the thesis underpinned the necessity of the applied variables. In some cases, for instance *modern contraception*, additional information was provided regarding the variable content. Besides, the purpose of interaction terms was explained.

4.4 Econometric Equations

The estimation for Niger and Senegal takes place with the help of identical econometric equations. Due to the analysis of cross-sectional data, the correlation in the disturbance term over different observations is ruled out. For that reason, autocorrelation is no threat to valid estimates. An advantage of cross-sectional data is the reasonable amount of comparability, that is being representative for the respective time point, and the property to examine groups, not individuals. Therefore, individual change cannot be reconstructed. A disadvantage is the limitation in data continuity, for instance household member classifications.

The introduction of the socio-economic variables leads to the following multivariate linear regression equation for the cross-sectional analysis.

$$\begin{aligned} \text{Children ever born to women aged 23-45}_i = & b_0 + b_1\text{Child death}_i + \delta_1(\text{Child death} \times \\ & \text{Young})_i + b_2\text{Household durables}_i + \delta_2(\text{Household durables} \times \text{Young})_i + b_3\text{Modern} \\ & \text{contraceptives}_i + \delta_3(\text{Modern contraceptives} \times \text{Young})_i + b_4\text{Respondent's education}_i + \\ & \delta_4(\text{Respondent's education} \times \text{Young})_i + b_5\text{Partner's education}_i + \delta_5(\text{Partner's education} \\ & \times \text{Young})_i + e_i \end{aligned} \quad (6)$$

In equation (6) b_0 displays the intercept, that is, the value of the dependent variable *children ever born to women aged 23 to 45* in case all independent variables assume value zero. The letter e represents the disturbance term, that is, e gathers all influences on the dependent variable which are not caused by the covariates. Subscript i represent unit effects.

The inclusion of maternal characteristics in the econometric equations has two important purposes. Firstly, in order to control for systematic differences between young and old mothers. Secondly, despite similar maternal characteristics in both age groups, their incorporation could diminish the error variance, and consequently reduce the standard error of δ (Wooldridge, 2004).

The independently pooled cross-section regression in (7) includes in comparison with the cross-sectional equation in (6) additionally year dummies which allow the intercept to differ by time period. Subscript t represents this time effect. While for Niger the baseline year is 1992, Senegal has the baseline year 1992-1993.

$$\begin{aligned} \text{Children ever born to women aged 23-45}_{it} = & b_0 + b_1\text{Child death}_{it} + \delta_1(\text{Child death x} \\ & \text{Young})_{it} + b_2\text{Household durables}_{it} + \delta_2(\text{Household durables x Young})_{it} + b_3\text{Modern} \\ & \text{contraceptives}_{it} + \delta_3(\text{Modern contraceptives x Young})_{it} + b_4\text{Respondent's education}_{it} + \\ & \delta_4(\text{Respondent's education x Young})_{it} + b_5\text{Partner's education}_{it} + \delta_5(\text{Partner's education} \\ & \text{x Young})_{it} + \text{Year 1997}_i / \text{Year 1998}_i + \text{Year 2005}_i / \text{Year 2006}_i + e_{it} \end{aligned} \quad (7)$$

In sum, the section on Econometric Equations indicated pros and cons of cross-sectional data and motivated the independently pooled cross-sectional approach. Besides, the the specified variables were introduced into the regression models. The presented models comprised a cross-sectional and an independently pooled cross-sectional variant.

5 Analysis

Chapter 5 shows the results from the investigation of the impact of socio-economic variables on the number of *children ever born*. Besides, the research hypotheses (presented in section 2.4) are evaluated. The chapter ends with a discussion of the performed analysis and points out potential analytical caveats.

5.1 Cross-sectional Regression Results – 1992 to 2006

Data management and analysis was performed using Stata 11.2/SE for Windows.

Table 4 reports the trends in mean values of the utilized socio-economic variables. The purpose is to illustrate developments across multiple cross-sections. The majority of mean values has experienced a change over time. However, the change seems more pronounced and frequent in Senegal compared to Niger. Table 4 shows that out of 10 variables, five stagnated in Niger, while Senegal indicated only one (1) such variable. It is notable that, apart from one (1) variable, stagnation in Niger concerns only interaction terms. Instead, large changes in variable mean values occurred more frequently in Senegal, for instance concerning *child death* and *household durables*.

Table 4: Trend in mean value over time. Samples from DHS data (2013): 1992, 1998, 2006 for Niger; 1992-1993, 1997, 2005 for Senegal

Variable/Country	Niger (1992 to 2006)	Senegal (1992-1993 to 2005)
Child death	downward ^{1, 2}	downward ²
Child death*young	downward	downward ¹
Modern contraceptives	stagnant	upward
Modern contraceptives*young	stagnant	stagnant
Respondent's education	upward	upward
Respondent's education*young	stagnant	upward
Partner's education	upward	upward ¹
Partner's education*young	stagnant	upward ¹
Household durables	upward ¹	upward ²
Household durables*young	stagnant	upward ^{1, 2}

Notes: 1) Trend not steady

2) Mean value difference between samples ≥ 0.1 ; exact mean values contains Appendix 3

Table 5 contains the cross-sectional regression coefficients. Since Breusch-Pagan tests indicated heteroskedasticity, all regressions used robust standard errors. In order to assess multicollinearity, the variance inflation factor (VIF) was applied. The largest VIF-value received in all regressions was 4.67. As a thumb rule, the literature points out value 10, but also value five appeared for relatively high multicollinearity. Therefore, correlation matrices were applied to control repeatedly for multicollinearity. None of the correlation matrices yielded a value larger than 0.8 which is considered to represent high multicollinearity. Thus, the latter is not presumed as a problem.

In order to test the overall significance of the model, F-tests were utilized. The results are shown in Table 5. All regressions possess highly significant p-values regarding the F-test. That is, the included independent variables do explain some of the variation in fertility behavior. R-squared, likewise displayed in Table 5, reports the size of the explained variation. According to the R-squared values, nearly half of the variation in fertility is explained by most of the models - which seems to be a quite reasonable share.

The results in Table 5 are quite revealing in several ways. First, a strong positive correlation is indicated between *child death* and *children ever born* for older women in all considered cross-sections on a 1% level of significance. This does not apply for Niger 1992. However, while the relationship is more pronounced in Niger, a steady downward trend occurs over time in both countries. Interestingly, among young women who experienced the event of a *child death*, the number of *children ever born* reduced. The estimates are highly significant with $p < 0.001$ values for all surveys in both countries.

The most striking result to emerge from the data is the correlation between the use of *modern contraceptives* and *children ever born* among older women. In this context, highly significant ($p\text{-value} < 0.001$) positive coefficients are perceived. The magnitude of the coefficients is across nearly all surveys quite pronounced. While the estimates decrease over time in Niger, Senegal displays a U-shape distribution. Among young women one (1) estimate remains insignificant for each country, but in different cross-sections. Across surveys, a negative impact of *modern contraceptives* on the dependent variable appears.

Respondent's education for older women shows the expected negative relationship with *children ever born*. While Senegal displays significant values in a U-shape form, the results for Niger yield only in the most recent survey a significant coefficient ($p\text{-value} < 0.05$). The interaction term is highly significant with $p\text{-values} < 0.001$ over all surveys. For young women in Niger decreases the negative relationship between *educated respondents* and their

children ever born over time. The same applies for Senegal, but in the last cross-section the negative impact on the dependent variable is rather small in comparison with Niger.

Table 5: Cross-sectional regression coefficients. Samples from DHS data: 1992, 1998, 2006 for Niger; 1992-1993, 1997, 2005 for Senegal

Variable/ Year	Niger			Senegal		
	1992	1998	2006	1992-1993	1997	2005
Child death	<i>Reference category: no child death older women</i>					
	4.10**	4.02***	3.83***	3.56***	3.53***	3.17***
Child death times young	<i>Reference category: no child death younger women</i>					
	-2.50***	-2.56***	-2.79***	-2.33***	-2.53***	-2.02***
Modern contraceptives	<i>Reference category: no modern contraceptives older women</i>					
	1.19***	1.07***	0.59***	1.35***	0.96***	1.31***
Modern contraceptives times young	<i>Reference category: no modern contraceptives younger women</i>					
	-0.68**	-0.78***	-0.25	-1.01	-0.44**	-0.80***
Respondent's education	<i>Reference category: older women without education</i>					
	0.28	-0.15	-0.35**	-0.46**	-0.37**	-0.72***
Respondent's education times young	<i>Reference category: younger women without education</i>					
	-1.09***	-0.97***	-0.90***	-0.92***	-0.89***	-0.54***
Partner's education	<i>Reference category: partner without education older women</i>					
	0.42	0.13	0.10	0.77***	0.26*	-0.01
Partner's education times young	<i>Reference category: partner without education younger women</i>					
	-0.63*	-0.27	-0.17	-0.44**	-0.15	-0.11
Household durables	<i>Reference category: no household durables older women</i>					
	-0.17	0.33	0.30*	0.09	0.12	0.03
Household durables times young	<i>Reference category: no household durables younger women</i>					
	0.07	-0.77**	-1.24***	-0.85	-1.21***	-1.13***
Intercept	3.23***	3.48***	3.75***	3.42***	3.46***	3.50***
N	3988	4528	5790	3841	5017	8061
F-value	265.30***	388.31***	475.44***	304.90***	444.78***	728.45***
R ²	0.42	0.45	0.43	0.42	0.43	0.43

Legend: Level of significance *p < 0.1; **p < 0.05; ***p < 0.001

The influence of *partner's education* on *children ever born* among old women seems rather weak. Across the surveys of Niger no estimator is shown significant. For Senegal only the first survey displays a highly significant coefficient (p-value < 0.001) while in the subsequent survey the magnitude and level of significance decreases (p-value < 0.05). Even less significant estimators are obtained for *educated partners* among young women. On a 10% level of significance *partner's education* has a negative impact on child-bearing in Niger. Instead, Senegal shows for 1997 a weak negative relationship (p value < 0.05) while the remaining estimators were insignificant.

The link between *household durables* and *children ever born* is predominantly positive for old women. However, merely one (1) single estimator is indicated significant on a 10% level. In general, the coefficients have a low magnitude. More drastic is the impact among young women. Especially the two most recent cross-sections indicate in both countries significant negative values of considerable magnitude.

In summary, this section examined initially the changes in variable mean values over time. The variation among variables was larger across the multiple surveys for Senegal. Besides, multicollinearity was assessed and the quality of the model reviewed. Significant correlation for old women was shown in the variables *child death* and *modern contraception*. Concerning young women a significant and pronounced link between *children ever born* and *child death*, *respondent's education* and *household durables* was found.

5.2 Independently Pooled Cross-sections Regression Results

As pointed out earlier, pooling independent cross-sections investigates the question of how the number of *children ever born* has changed over time after controlling for other observable factors. Table 6 provides the regression results for both countries with the associated control variables. The base year for Niger is 1992 and for Senegal 1992-1993.

Due to a p-value < 0.001 in the Breusch-Pagan test for both countries, the regressions used robust standard errors as corrective measure for heteroskedasticity. According to the largest VIF value (3.68) and the values in the correlation matrix of around 0.5 no multicorrelation is assumed to exist among the independent variables. The F-test for both countries shows significant p-values at the 1% level. That is, at least one (1) variable in the model differs from zero. The R-squared value shows the fraction of variation in *children ever born* which is explained by the regression.

Within the pooled cross-sectional approach, the interest lies especially in the introduced *year dummies*. The obtained *year dummy* coefficients are all significant, but to a changing extent. Concerning Niger, the *year dummies* display a positive development in *children ever born* across time after controlling for the observed factors. This relationship increases slightly over time. Senegal displays the exact opposite, that is a decline in fertility. In a temporal comparison between baseline year (1992-1993) and most recent survey (2005), the change over time is more pronounced in Senegal than in Niger.

All significant year dummy coefficients show changes in the dependent variable *children ever born* that are not attributable to the explanatory variables.

Table 6: Independently pooled cross-section regression coefficients. Pooled samples from DHS data: 1992, 1998, 2006 for Niger; 1992-1993, 1997, 2005 for Senegal

Variable/ Country	Niger	Senegal
Child death	3.95***	3.38***
Child death times young	-2.62***	-2.27***
Modern contraceptives	0.89***	1.23***
Modern contraceptives times young	-0.52***	-0.75***
Respondent's education	-0.16	-0.55***
Respondent's education times young	-0.95***	-0.74***
Partner's education	0.18	0.21**
Partner's education times young	-0.29**	-0.18**
Household durables	0.19	0.05
Household durables times young	-0.75***	-1.05***
Year 1998/ Year 1997	0.12**	-0.09*
Year 2006/ Year 2005	0.16***	-0.22***
Intercept	3.43***	3.60***
N	14306	16919
F-value	929.69***	1268.36***
R ²	0.43	0.43

Legend: Level of significance *p < 0.1; **p < 0.05; ***p < 0.001

In sum, this part of the thesis assessed initially the quality of the independently pooled cross-sectional model. Next, changes over time in the dependent variable *children ever born* were presented while controlling for observable factors. The countries show fertility developments in opposite direction with a higher magnitude in the long perspective in Senegal.

5.3 Discussion

Before discussing the results of the independently pooled cross-sectional analysis, the focus is on the year-by-year outcome. A strong relationship between *child mortality* and *children ever born* has been reported in the literature. Accordingly, *Hypothesis 1* in section 2.4 was that *child mortality* is related to the number of *children ever born*, particularly among old women. This study confirms the relationship for both countries. However, the relationship is more distinctive across surveys of old women in Niger than in Senegal. In the most recent

survey experiencing a *child death* and everything else being equal, on average an old woman in Niger received 3.83 more children in contrast to 3.17 in Senegal. It seems possible that this inter-country difference is due to the earlier illustrated issues in food supply and health care, for instance regarding malaria prophylaxis. Among young women the relationship is quite the opposite. A possible explanation for this pattern between old and young women might be that the younger ones perceive the decline in *child mortality* as irreversible. In contrast, for older women the decline in *child deaths* is a more recent phenomenon so that they maintain a higher number of insurance births.

The second hypothesis expected a negative effect of *household durables* on the number of *children ever born*. This link was presumed to be more pronounced among young women. Surprisingly, apart from a single survey in Niger, all other coefficients for old women remained not significant. Since the significant coefficient (p-value < 0.1) indicates a weak positive impact on *children ever born* Hypothesis 2 is on the first stage disproved. However, the two most recent surveys among young women depicted highly significant estimates, by which Hypothesis 2 is partly confirmed. For instance, in the most recent survey the existence of *household durables* and ceteris paribus, young women in Niger received on average 1.24 children less in comparison with 1.13 less offspring in Senegal. These findings support the idea that young females could have easier access to *household durables*. Moreover, indicate the used items indirectly the availability of electricity, and thus developmental progress. Surprisingly, both countries show rather similar patterns in this respect. This is in contrast with the information provided in the Country Profiles in section 2.1 where Senegal displayed a far more developed background, particularly with respect to electricity and associated areas, for instance the internet. This inconsistency may be due to rural-urban inequalities that mask the actual relationship. That is, under the likely scenario that urban women possess more *household durables* than rural females, the samples might contain a larger share of women with an urban background in Niger, in contrast to a predominance of rural women in the Senegalese sample.

Hypothesis 3 concerned *respondent's education*. A negative relationship was expected between *respondent's education* and *children ever born* – with a larger magnitude assumed among young mothers. The regression result displayed for Niger only one (1) significant estimate among old women. Instead, Senegal indicated all three coefficients significant. In the last investigated survey, other factors being equal, old *respondents with education* in Niger gave on average birth to 0.35 less children compared to 0.72 less offspring in Senegal. The observed correlation confirms *Hypothesis 3*. That is, the results are more pronounced among young women in both countries. However, while the estimate decreased across

Senegalese surveys, Niger records a plateau lately. It is somewhat surprising that the impact of *respondent's education* is initially relatively identical among young females, while old women show decisive differences between the countries. A possible explanation might be that the effect of *respondent's education* of old women in Niger was channeled to other observed or unobserved factors. As a consequence, the estimator remains insignificant.

Partner's education and *modern contraceptives* are two additional control variables in the model. The effect of *partner's education* on the dependent variable is positive. However, only few estimates turned significant. It is interesting to note that among old women *partner's education* is relatively significant in Senegal, but not at all in Niger. Nevertheless, the positive relationship in Senegal decreased over time which suggests surprisingly an independency between *partner's education* and females' birth behavior. In Senegal, having a *partner with education* and, *ceteris paribus*, the number of *children ever born* to old women on average increased by 0.77 in 1992-1993 compared to merely 0.26 more children in 1997. Despite the relatively weak relationship between *partner's education* and reproductive behavior, the positive effect might be explained by higher household income due to its dependency on education. In addition, the effect could be overestimated if foster or non-biological children not only lived in the household, but were mistakenly reported as biological children.

This study has been unable to demonstrate for old women a negative relationship between *modern contraceptives* and *children ever born*. Instead, highly significant ($p\text{-value} < 0.001$) positive estimates were obtained in this context. While the positive impact decreases in Niger, Senegal shows a U-shaped curve. Everything else being equal, the use of *modern contraceptives* increased fertility in Niger on average by 0.59 children in the latest survey, while old Senegalese women experienced a rise of 1.31 *children ever born*. Among young women, the magnitude of all significant estimators increased over time. When applying *modern contraception*, and *ceteris paribus*, on average a young woman in the 1998 survey in Niger decreased *fertility* by 0.78 children. In the survey 1997 for Senegal young women received on average 0.80 less children. Since the positive relationship among old women has not been found elsewhere in the literature it is probably not due to an inadequate use of *modern contraceptives*. A possible explanation, as indicated by Cohen (1998), may that reversible methods of *modern contraception* are used merely to space pregnancies and not to stop childbearing altogether. The difference in outcomes between old and young women is conceivable to result from the fact that young women consider the spacing of their reproductive behavior as more important as old women do.

In applying pooled cross-sectional analysis, this study found a slight upward trend regarding the number of *children ever born* over time in Niger. Instead, Senegal indicated a decline. When holding all observed factors fixed in Niger, women received on average 0.16 more children in 2006, then in 1992. In contrast, holding all observed factors fixed in Senegal, women had on average 0.22 less children in 2005 compared to 1992-1993. Since controlling for *child mortality*, *modern contraceptive use*, *household durables*, *respondent's* and *partner's education*, the respective change is separate from the respective rise or decline in *children ever born* that is due to the average variation in these variables over time. This result affirms the divergence in fertility patterns between both countries as indicated by UN data (see Appendix 1 for a graph), and seems to be in accordance with the interrelationship between the investigated socio-economic variables and the number of *children ever born*.

Concerning the research question, the results above yield the following. Major differences in the investigated socio-economic determinants of fertility occurred for *child death*, *respondent's education* and *household durables*. For instance, when *child death* was experienced among old women, the positive relationship towards larger family size is more pronounced in Niger. Young women display the opposite relationship. This interrelation turns out to be more pronounced in Niger too, particularly obvious in the last survey. Older *respondents with education* in Senegal experienced a decline in fertility, while no such relationship was found for Niger. Among young women, the negative relationship is decreasing in Niger and Senegal over time. Concerning *household durables* the analysis showed only one (1) significant estimate (p-value < 0.1) for old women. However, young women in both countries displayed a quite pronounced negative relationship between *household durables* and *children ever born* for the two most recent surveys. In the final survey, *ceteris paribus*, *household durables* led on average to 1.24 less children per women in Niger and to 1.13 less offspring in Senegal.

The above presented statistical estimates have to be interpreted with caution. Several methodological issues could complicate their interpretation. While studying fertility, endogeneity is one (1) critical issue. According to Wooldridge (2004), this issue arises due to unobserved variables which jointly determine dependent and independent variables. As a consequence, correlation does not equal causation. Simultaneity, a form of endogeneity, is a further critical issue. Simultaneity occurs if one (1) or more of the independent variables are jointly determined with the dependent variable. The consequence of ignoring simultaneity is an upward or downward bias. For instance, it might be expected that higher rates of *modern contraceptive use* reduce the fertility rate, *ceteris paribus*, a downward bias implies that OLS will overestimate the impact of more *modern contraceptive use*. Good proxy variables can

resolve a bias due to omitted variables (Wooldridge, 2004). For instance, if estimating the effect of education on fertility, then unobserved ability blurs the result. Instead, introducing a proxy variable, such as IQ, provides a consistent estimator. However, the variable IQ is not adequate for the instrumental variable (IV) approach which addresses endogeneity and simultaneity problems. The reason is that IQ must be uncorrelated with ability, which is obviously not the case. Wooldridge (2004) states that the IV-methodology is highly dependent on reliable IV, which in turn depend on the availability of exogenous variables in the dataset in order to obtain consistent estimates. The solution might be to combine datasets that contain the required exogenous variables. However, the caveat of IV estimation is the requirement of a not testable exclusion restriction. The exclusion restriction rules out direct effects of the IV on a testable dependent variable or effects due to omitted variables.

A further concern in fertility analysis is the detachment between the event of birth and later life situations, for instance consecutive birth events. According to Rafferty (2011), cross-sectional data cannot capture the effects between two or several points in time. Surveys are merely a snapshot and a reoccurrence of units in more than one (1) cross-section is at most coincidence. Despite the use of repeated cross-sectional data, the elimination of systematic fluctuations in variable values of a given year is impossible, and thus affects findings. Rafferty (2011) argues that simultaneously, age, cohort or period effects are hardly to distinguish. As a result, age effects cannot clearly be assigned to differences among younger and older individuals, differences between younger and older cohorts, for instance a drought that increased infant mortality or factors present at the time of observation.

The utilization of *children ever born* comprises measurement issues. Error may occur due to incorrect recall of mothers. This relates especially to offspring that died young or has left home. In addition, illegitimate children may be omitted, but instead non-biological offspring reported, for instance step-children. A further issue might comprise coding practices. The failure to record childlessness by the fieldworker could lead to a 'not stated' code in the questionnaire. Hence, the exclusion of these women will result in an upward bias in the mean number of *children ever born*. Instead, including such respondents, by coding their parity to zero, will underestimate the mean number of *children ever born* due to the likelihood of childless women in the dataset (e.g. Hirschman & Guest, 1990; South Asia Fertility Project).

To sum up, this section provided results of the cross-sectional and pooled cross-sectional analysis. Additionally, findings were discussed and the formulated research hypotheses evaluated. Finally, the illustration of methodological issues took place.

6 Conclusion

This thesis has investigated persistent high fertility in Niger. The aim was to examine possible differences in the factors of reproductive behavior between Niger and Senegal which may explain high fertility patterns. In order to discover potential fertility patterns, the study compared socio-economic drivers of fertility in Niger – a pre-transitional country – with those in Senegal – an early transitional country. One of the more significant findings to emerge from this study suggests differences between young and old women regarding their reproductive behavior.

Governments may use various strategies and interventions in order to tackle high fertility. However, a universally valid statement is that individuals should not be patronized regarding their reproductive rights. The implications of this study suggest two main pillars that policies should address in order to encounter persistent high fertility in Niger. Firstly, ensure *educational attainment*, especially among young women as the prospective mothers. *Educational attainment* appears to contribute to, among others, significant health and mortality differences in the number of *children ever born*. Secondly, ensure sources of income. *Household durables* as proxy of income seem to suggest that the material aspirations or the size of the household budget play a decisive role regarding persistent high fertility.

A number of caveats need to be noted regarding the present study. First, the applied methodology cannot link the occurrence of child-bearing with the relevant life situation of the mother and her partner. That is, the circumstances of initial child births may differ considerably from births that took place in later life. Second, the entire analysis omits to take into consideration the household income of the parents, despite the previously proven importance. Finally, while the methodological framework allows observing correlations, the derivation of causation suffers from unobserved variables, among others.

This research has thrown up many questions in need of further investigation. Further work needs to be done to establish whether the nationally aggregated data used in this study masks regional disparities or differences between social groups. Another interesting issue for prospective research is on the interrelation of care-giving responsibilities to non-biological children and the demand for biological offspring. To enable this research, accurate and consistent data on in- and out-fostering practices would be essential.

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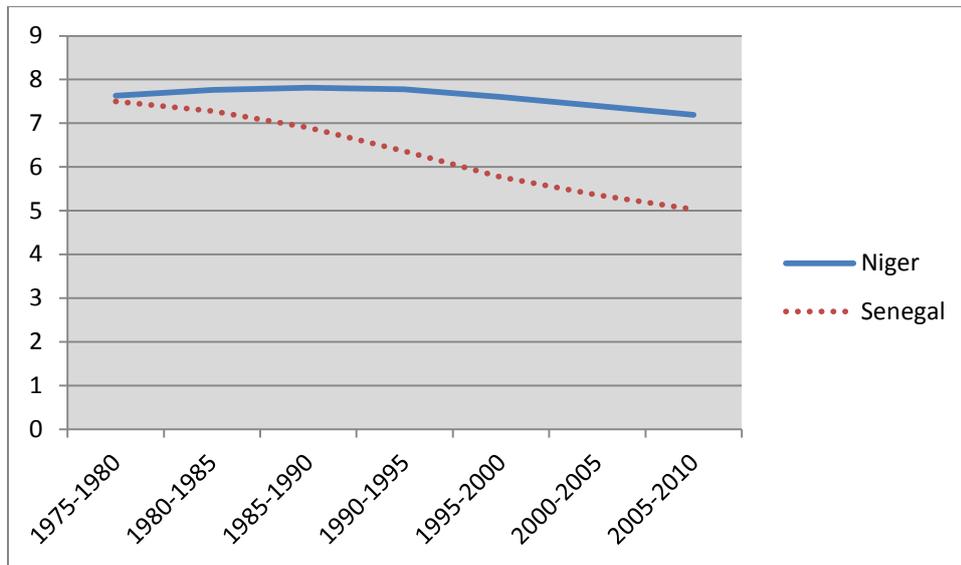
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Appendix

Appendix 1: TFR Niger and Senegal 1975-2010



Source: UN, Department of Economic and Social Affairs

Appendix 2: Map of West Africa



Source: people.eku.edu

Appendix 3: Descriptive statistics – independent and pooled cross-section Niger and Senegal

Variable	Country	Survey	Obs.	Mean	Std. Dev.	Min	Max
Children ever born to women aged	Niger	1992	4020	4.99	2.84	0	16
		1998	4547	5.34	2.90	0	15
		2006	5866	4.98	2.90	0	16

Appendix

23-45		pooled	14433	5.10	2.89	0	16	
		Senegal	1992-93	3856	4.61	2.91	0	15
			1997	5246	4.41	2.86	0	16
			2005	8334	3.87	2.77	0	14
			pooled	17436	4.20	2.85	0	16
Modern contraceptives used among women aged 23- 45	Niger	1992	4020	.061	.241	0	1	
		1998	4547	.077	.267	0	1	
		2006	5866	.179	.383	0	1	
		pooled	14433	.073	.260	0	1	
	Senegal	1992-93	3856	.064	.245	0	1	
		1997	5246	.089	.285	0	1	
		2005	8334	.099	.298	0	1	
		pooled	17436	.088	.284	0	1	
		Niger	1992	4020	.615	.486	0	1
			1998	4547	.639	.480	0	1
2006	5866		.516	.499	0	1		
pooled	14433		.582	.493	0	1		
Senegal	1992-93		3856	.471	.499	0	1	
	1997	5246	.037	.190	0	1		
	2005	8334	.352	.477	0	1		
	pooled	17436	.406	.491	0	1		
	Household durables among women aged 23- 45	Niger	1992	3988	.118	.323	0	1
1998			4528	.095	.294	0	1	
2006			5790	.151	.358	0	1	
pooled			14306	.124	.330	0	1	
Senegal		1992-93	3841	.228	.419	0	1	
		1997	5017	.238	.426	0	1	
		2005	8061	.457	.498	0	1	
		pooled	16919	.340	.473	0	1	
		Niger	1992	4020	.134	.340	0	1
			1998	4547	.166	.372	0	1
2006	5866		.191	.393	0	1		
pooled	14433		.167	.373	0	1		
Senegal	1992-93		3856	.221	.415	0	1	
	1997	5246	.249	.432	0	1		
	2005	8334	.308	.461	0	1		

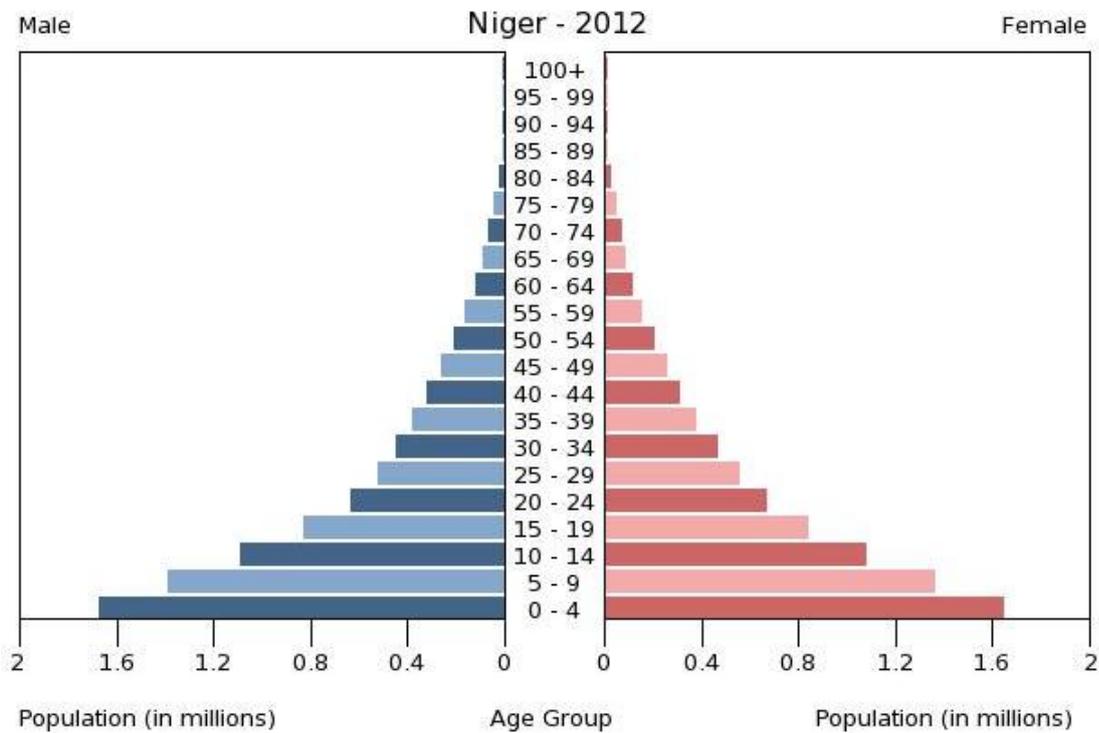
Appendix

		pooled	17346	.156	.362	0	1
Partner's education for women aged 23- 45	Niger	1992	4020	.111	.315	0	1
		1998	4547	.130	.336	0	1
		2006	5866	.179	.383	0	1
		pooled	14433	.145	.352	0	1
	Senegal	1992-93	3856	.163	.369	0	1
		1997	5246	.169	.375	0	1
		2005	8334	.222	.416	0	1
		pooled	17436	.193	.395	0	1
Modern contraceptive times young	Niger	1992	4020	.038	.191	0	1
		1998	4547	.040	.198	0	1
		2006	5866	.039	.195	0	1
		pooled	14433	.039	.195	0	1
	Senegal	1992-93	3856	.026	.159	0	1
		1997	5246	.037	.190	0	1
		2005	8334	.041	.199	0	1
		pooled	17436	.036	.188	0	1
Child death times young	Niger	1992	4020	.290	.454	0	1
		1998	4547	.244	.430	0	1
		2006	5866	.200	.400	0	1
		pooled	14433	.239	.426	0	1
	Senegal	1992-93	3856	.148	.355	0	1
		1997	5246	.146	.353	0	1
		2005	8334	.115	.319	0	1
		pooled	17436	.131	.338	0	1
Household durables times young	Niger	1992	3988	.071	.257	0	1
		1998	4528	.051	.220	0	1
		2006	5790	.074	.263	0	1
		pooled	14306	.066	.248	0	1
	Senegal	1992-93	3841	.123	.328	0	1
		1997	5017	.118	.322	0	1
		2005	8061	.234	.423	0	1
		pooled	16919	.174	.379	0	1
Respondent's education times young	Niger	1992	4020	.094	.292	0	1
		1998	4547	.103	.304	0	1
		2006	5866	.107	.310	0	1

	Senegal	pooled	14433	.102	.303	0	1
		1992-93	3856	.123	.328	0	1
		1997	5246	.136	.343	0	1
		2005	8334	.183	.387	0	1
		pooled	17346	.156	.362	0	1
Partner's education times young	Niger	1992	4020	.076	.265	0	1
		1998	4547	.079	.270	0	1
		2006	5866	.095	.294	0	1
		pooled	14433	.085	.279	0	1
	Senegal	1992-93	3856	.078	.269	0	1
		1997	5246	.077	.266	0	1
		2005	8334	.114	.318	0	1
		pooled	17436	.095	.293	0	1
Year (pooled)	Niger	1998	14433	.315	.464	0	1
		2006	14433	.406	.491	0	1
	Senegal	1997	17436	.300	.458	0	1
		2005	17436	.477	.499	0	1

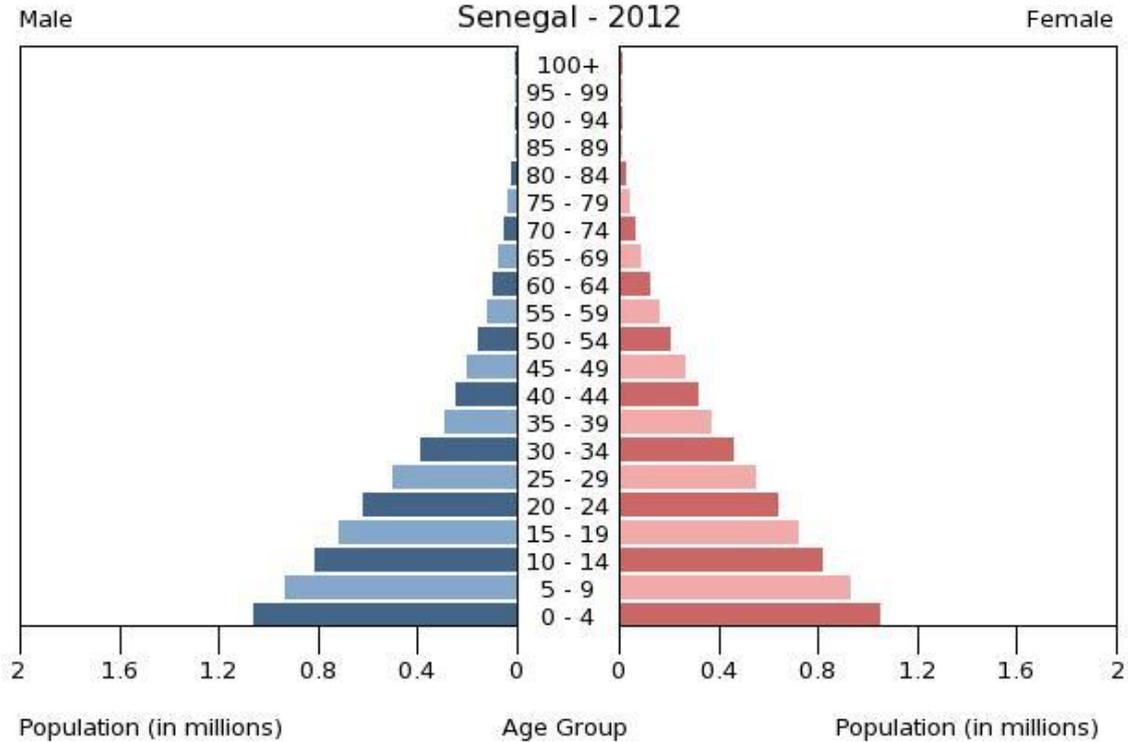
Source: DHS samples Niger (1992, 1998, 2006) and Senegal (1992-93, 1997, 2005)

Appendix 4: Population pyramid Niger 2012



Source: CIA Factbook, 2013

Appendix 5: Population pyramid Senegal 2012



Source: CIA Factbook, 2013