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FERTILITY TRANSITIONS IN SUB-SAHARAN AFRICA: TRENDS IN DECLINING FERTILITY

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ABSTRACT

Every developed country has gone through a demographic transition, where both mortality and fertility decline as societies modernize and develop industries. In addition, much of Asia and Latin America have experienced both mortality and fertility transitions. Sub-Saharan Africa, however, is in the beginning stages of the fertility transition. Using data from the Demographic and Health Surveys (DHS), this paper will examine how and where fertility has changed in recent years in sub-Saharan Africa, including changes in national total fertility rates, fertility rates in rural versus urban areas, and differences between capital cities compared to other urban areas and rural areas. It will also consider changes in age-specific fertility rates in the four major regions of sub-Saharan Africa. This paper confirms the findings of Shapiro and Tambashe (2002) that Africa is going through a three-stage fertility transition process, where fertility rates first fall quickly in urban areas, then fertility falls in both rural and urban areas, but faster in urban areas, and lastly when overall fertility levels are relatively low, rural fertility rates declines more quickly than urban fertility rates.

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Chapter 1

Introduction

Sub-Saharan Africa makes up the majority of the continent of Africa and is comprised of all African countries south of the Saharan desert. It is often considered the least economically developed region in the world. According to data from the World Bank, the gross national income (GNI) per capita is $1,657, compared to a GNI per capita of $35,551 for countries in the European Union (World Bank, 2013). In addition, areas in sub-Saharan Africa have some of the highest levels of fertility worldwide. As this paper will describe, there are distinct connections between the economy and fertility. As countries develop, their fertility rates drop: this is known as the fertility transition. Every developed country and many developing countries, including those in Latin America and Asia, have gone through this transition. Sub-Saharan Africa has just recently begun to experience fertility decline.

This paper will examine fertility declines in different types of areas across the region, including rural areas, urban areas, and capital cities. It will also consider at what age ranges women are experiencing fertility decline fastest. This information is vital to attempt to understand why certain regions have already experienced fertility decline and how policy makers can help to promote the spread of fertility decline in the future. In order for sub-Saharan Africa to continue to develop economically and potentially close the gap with its more developed counterparts, it is essential for the region to continue to lower its rates of total fertility.

First, this paper will give a background on the current literature on this topic. It will describe the studied link between the economy and fertility. As societies develop, they

experience fertility decline, and lower fertility levels are important for continued economic growth due to negative implications of high fertility rates. It will then describe the trends in fertility transitions globally and if they have thus far been similar to or different than the trends sub-Saharan Africa is experiencing. It will discuss historic changes in age-specific fertility transitions, or at what ages women are having children less frequently than in the past. This paper will use data collected from the Demographic and Health Surveys (DHS) Program. It uses the most recent data available as of late 2014, so will be more inclusive of recent information than research published in the past.

To study the results, I will first discuss changes in national total fertility rates (TFR), differences between urban and rural areas, differences in capital cities, general changes in fertility over time, and age specific fertility transitions in the region. I will confirm the three-stage fertility transition process, where fertility rates first fall quickly in urban areas, then fertility falls in both rural and urban areas, but faster in urban areas, and lastly when overall fertility levels are relatively low, rural fertility rates declines more quickly than urban fertility rates. I will lastly discuss the conclusions I drew from this information and its importance for the region, as well as potential areas for future research.

Chapter 2

Review of the Literature

Fertility and Economics

In 2010, the average Total Fertility Rate (TFR) of the world was found to be 2.52 children (United Nations, 2011). TFR is defined as the hypothetical average number of children a woman will have based on current age-specific fertility rates. It is the average number of children born to a woman in her lifetime (Population Reference Bureau, 2014). However, there are large differences in fertility between regions, countries, and continents. This is due to cultural, geographical, and economic factors. One can attempt to predict fertility trends based on economic factors present in a region or time period. If one examines fertility from an economic perspective, one can determine why households have high or low demand and supply of children, and thus can determine why a fertility rate is at a certain level, and where it will likely be in the future.

Becker (1960) discussed the demand for children, and when and why parents would desire more children. Easterlin (1975) later added to and extended this theory. He developed his own model of fertility that included the supply of children and the cost of fertility regulation. By doing this, he helped to provide a framework that was from an economic mindset, but also incorporated perspectives from other disciplines. With these two theories, we can study children similarly to any other "good" in the economy. Fertility rates are impacted by three major factors: the demand for children, or the ideal number of children for parents, the supply of children, or the number of children parents would have if they did not take action to limit fertility, and the costs of fertility regulation (Easterlin, 1975).

The demand for children is determined by the same factors as the demand for any other good: income, prices, and tastes. For normal goods, we assume that as income increases, you will purchase more of the good because you have more money. Children are considered a time-intensive commodity. Therefore, as a woman's wage increases, she will actually likely have fewer children because the opportunity cost of not working rises. Wage is part of the price of children: because children are time-intensive, a woman's potential wage is a key variable in the price of kids, because it is the amount of money a woman will miss out if she must stay home from work to raise children. The higher opportunity cost makes children more expensive for those whose income is higher (Becker, 1960). Importantly, the level of education a woman has obtained is a significant factor in potential earning power, and thus fertility rates. There is an inverse relationship between women's education and fertility (Bongaarts, 2010).

Households also must consider the concept of quality versus quantity. When we think of normal goods in economics, we would typically expect consumption to increase as wages increase, because you can afford to buy more. However, when studying fertility, this increased demand for children is not reflected so much in more children, but rather in "higher quality" children. As households become wealthier, they look not just at the number of children they can afford; they must consider the tradeoff between quality and quantity. When you have fewer children, more money can be spent on each child, for example on education and healthcare (Becker and Lewis, 1973). Higher quality children could also indicate the ability of parents to spend more time with each child. For wealthier families, a higher quality child becomes more important than simply having as many children as possible (Becker, 1960).

Another factor parents may consider is the ultimate payback children will have. In rural areas in particular, children working can contribute to the household income. This is less true in

urban areas. As the amount a child can contribute increases, net cost of a child decreases, and thus demand will increase. Children can also serve as a form of "social insurance." Children will help to support parents in old age, so parents may be more motivated to have more children (Becker, 1960). This social insurance is particularly relevant in developing countries, where the government is less likely to provide social security or other forms of assistance for retired or elderly individuals.

We can also consider the costs of fertility regulation. In most developed societies today, there are relatively low costs to contraception. Costs include the amount parents must pay to purchase contraception and the amount of time needed to purchase and use contraception. There are also subjective costs, such as the displeasure a couple experiences when using contraception. In other societies, however, costs are greater. Families may not have knowledge of or access to contraception (Becker, 1960). To limit the number of children they have, families can choose to abstain, either through delayed marriage or less frequent intercourse. Abortion can also be utilized to control fertility. However, there are often social factors that limit the feasibility of these options. For example, there are social stigmas associated with abortion and strong cultural pressures to be married at a certain age (Becker, 1960). If costs of fertility regulation are high, there will be more unwanted children and the number of children a family has will not necessarily correlate to the number they desire (Easterlin, 1975).

The supply of children is the number of surviving children a household would have if fertility were not deliberately controlled. There are two factors that impact child supply: natural fertility and likelihood of survival for a child. Natural fertility is determined by several biological factors, such as sterility and fecundity. There are also cultural factors, such as societal expectations to avoid intercourse while a mother is nursing (Easterlin, 1975). Likelihood of

survival for a child is primarily determined by knowledge of and access to medicine and healthcare. More educated and wealthier women tend to have higher survival rates of children.

Fertility has been greater in rural areas than in urban throughout time and across the world. This is due to several of the reasons listed above. Parents tend to depend on their children as contributors to household income in rural areas more than in urban areas (Shapiro and Tambashe, 2002). The opportunity cost of children in rural areas is also lower, because wages tend to be lower. Opportunities for higher education are more readily available, particularly for women, in urban areas. Wealthier parents in urban areas are more likely to emphasize high quality children, who can attend universities and less likely to emphasize quantity, especially when more children does not mean a greater household income (Becker and Lewis, 1973). Another theory suggests fertility is higher in rural societies to compensate for high mortality rates (Notestein, 1953). If parents know infant mortality rates are high, they may have more children knowing that some may not survive. This allows their actual number of surviving children to more closely match their desired number of children.

Negative Impact of High Fertility

The issue of high fertility rates has important implications for the sub-Saharan African economy and society as a whole. Studying this topic is thus important for the future economic well being of sub-Saharan Africa. John Casterline and Robert Lazarus (2010) identified four key areas where high fertility rates have important consequences: child and maternal health, child schooling, economic growth, and natural environment. In part due to the implications of high fertility rates, international agencies have worked to implement family planning programs to slow fertility rates and population growth.

Children from families with more children are more likely to die before they reach late childhood. Having a short period of time between each birth has also been identified as a risk factor for low birth weight, premature birth, and relatively small size for infants (Casterline and Lazarus, 2010). Mothers are also at greater risk when they have more children: women having their fifth or sixth child have a 50 percent higher mortality rate due to maternal causes. Having fewer children also puts you at risk for maternal mortality less frequently, so also lowers risk (Campbell and Graham, 2006). It is important to note that as aforementioned, families may have more children when they anticipate some of their children will not survive. In other words, there is a correlation between larger families and high infant and child mortality rates, but we cannot confidently determine a causational relationship.

As previously discussed, parents must consider the tradeoff between quality and quantity of children when deciding how many children to have. Parents might have fewer children so that they are able to invest more in the future education of the children they do have. Children who have many siblings typically have less schooling. Parents of large families must distribute their

resources to allow all their children to have some education, instead of being able to invest more money in their children reaching high levels of education (Casterline and Lazarus, 2010). Therefore, when fertility rates are high, there will be more children who are less educated in the society. This could mean individuals are less productive and less likely to add to the economy and society.

Casterline and Lazarus (2010) next argue that declines in fertility rates allow for economic growth. Although we cannot determine that there is an exact causal relationship between high fertility rates and economic growth, there are correlations between these two factors. There is a concept knows as the "demographic dividend," which describes the potential economic gains from a fertility decline. As fertility rates fall, a greater percent of the population is within working age. This means that income per capita is greater. Fewer resources are required for expenditures on children's health and education. In accordance with Becker's quantity-quality trade-off model, parents are able to develop higher quality children when they have fewer children. Women with fewer children are more likely to be able to work, which increases labor supply and thus also increases income per capita (Bloom, Canning, Fink, and Finlay, 2009).

When fertility rates are higher than mortality rates, population grows. This can have negative impacts on the natural resources available in a society. We have seen a wide variety of environmental issues such as global warming, ozone layer depletion and deforestation. These issues are exacerbated by overpopulation. As the world population continues to grow, we may see depletion in nonrenewable resources. These issues are global, but there are also environmental problems that will affect a specific society with high fertility rates: issues with air quality, lack of fresh water, and declines in biodiversity (Casterline and Lazarus, 2010).

Fertility Transitions

As previously discussed, economic factors play a key role in fertility rates and there are economic implications of high fertility. It has been established that there is a demographic transition relating to the economy: as societies modernize and develop industries, there are shifts in their demographics. Before the shift, the population stays relatively stable. There are high birth rates, which help to compensate for high death rates. Populations grew slowly because there was a positive replacement fertility rate, meaning fertility rates were greater than mortality and the population is more than replacing itself (Bongaarts, 2009).

The first stage of the demographic transition is characterized by death rates declining. Improvements in economic conditions extend life expectancy for several reasons. Societies can do a better job of sustaining food supply even when there are local crop failures when they are able to trade with other regions. Trade also allows for more diverse diets and better nutrition. Societies developed public sanitation systems and improve the diagnosis, treatment, and prevention of diseases (Cutler, Deaton, and Lleras-Muney, 2006; Lee, 2003).

In this stage, despite falling death rates, fertility remains high. Although parents no longer have extra children to ensure the same number of surviving children, attitudes towards fertility reduction (such as attitudes towards appropriate age of marriage and attitudes towards contraception) do not immediately shift. After the first shift, there is a lag as fertility changes adjust to the changing mortality rates (Bongaarts, 2009). With high fertility rates and low mortality rates, therefore, the population is growing quickly.

In the third stage, the birth rate also declines and population growth is again near zero. Both rates stabilize at relatively low levels (Bongaarts, 2009). Every developed country and most developing countries outside of sub-Saharan Africa have experienced this transition (United

Nations, 2011). Parts of Europe are currently experiencing sub-replacement fertility, meaning their population is declining as fertility rates do not compensate for the number of deaths.

Age-Specific Fertility Transitions

When examining age-specific fertility transitions, we consider at what ages fertility falls the most. There are some general fertility trends due to biological factors: fertility is unlikely at very young and very old ages. Fertility typically peaks somewhere between the ages of 20-34, depending on the region.

There are several different hypotheses that theorize what age groups are impacted the most by the fertility decline, and why. Without examining data, one might expect that fertility would decline most at ages 20-24. This is because average age of childbirth has been getting older as time has gone on, so there is more room for declines at younger ages. Conversely, van de Walle and Foster (1990) found that in sub-Saharan Africa, fertility falls most significantly for women at relatively old ages. Caldwell, Orubuoye, and Caldwell (1992) believed that fertility would fall about equally across all age groups. Contrary to van de Walle and Foster's (1990) findings, they do not believe changes would take place mostly with older women. Bongaarts and Casterline (2013) found different results. They did not find evidence to support the theory that fertility would fall at all ages.

In the "Age-specific Fertility" sub-section of my results, I will examine changes in age-specific fertility rates with the most recent data in all of sub-Saharan Africa. I also compare changes across regions. Interestingly, there are substantial differences between the four regions

(Western, Eastern, Southern, and Middle sub-Saharan Africa). Therefore, it may be difficult to draw conclusions about age-specific fertility for the entire region.

Fertility Transitions in sub-Saharan Africa

According to recent research, most of sub-Saharan Africa is at the very early stages of this fertility transition. The healthcare benefits gained from the industrial revolution have not reached this region to the same extent as in the developed world. There have been low levels of socioeconomic development. The HIV/AIDS epidemic serves as the leading cause of death in sub-Saharan Africa and increased mortality in the 1990s (Lee, 2003). Other factors such as malaria, hunger, and war have contributed to the relatively high mortality rates.

Fertility decline began in the mid-1960s in Latin America and slightly later in Asia. Decline in fertility in Africa did not begin for approximately another twenty years. Not only did fertility decline begin later, it is also declining at a slower pace (Bongaarts and Casterline, 2013). In addition to the slower economic development in sub-Saharan Africa, there are cultural and political factors that restrict the decline of fertility. For example, women in Africa are married at relatively young ages. Although the average age is increasing, earlier marriage means early and overall more frequent intercourse, and thus more children (Cohen, 1998).

Contraception use also plays an important role in levels of fertility. The demand for contraceptives among unmarried women in the region is growing, but access and social stigmas keep use relatively low (Caldwell et al. 1992). However, long periods of breastfeeding lengthen infecundity (Cohen, 1998) and social stigmas associated with intercourse immediately postpartum help maintain lower levels of fertility naturally (van de Walle, 1991).

Shapiro (2012) identified two key factors that have played a vital role in the falling fertility rates in sub-Saharan Africa. In recent years, sub-Saharan Africa has increasing levels of women's educational attainment and decreases in infant and child mortality rates. These two factors both promote fertility decline for several reasons. As mentioned above, one reason some households have many children is due to high mortality rates. They have more children in case some of their children pass away to ensure they have their target number of children. Once mortality rates fall, this is no longer true. The natural supply of children increases, so there is an increased motivation to utilize methods to control fertility. As infant and child mortality rates fall, although natural supply increases the final number of children will decrease (Shapiro, 2012).

The increased opportunity for education also promotes lower levels of fertility for several reasons. This impacts the demand and supply of children and the costs of fertility regulation. Better-educated women typically also have higher wages and overall wealth. This increases the cost of children due to higher opportunity costs of children. Therefore, they will have a lower demand for children because of the wages they would be otherwise earning. Women with higher levels of education also are more likely to emphasize quality over quantity of children. In this tradeoff, more educated women sacrifice high numbers of children so that they can allocate more resources towards their children. Better educated women often have knowledge of and access to more healthcare opportunities. They thus have lower rates of infant and child mortality. As described above, this will also decrease fertility rates. Lastly, the relative cost of fertility regulation are lower for more educated women. The amount of money spent on fertility regulation is relatively small compared to the potential wages women could be earning, so they are more motivated to control fertility (Shapiro, 2012).

Contribution of this Thesis

Much research has been done about fertility transitions across the world and specifically in sub-Saharan Africa. Specifically, David Shapiro and Basile O. Tambashe (2002) have written about the recent fertility transitions in this region. Their paper used data from 49 Demographic and Health Surveys (DHS) from 29 different countries. These data are based on surveys that were conducted between 1986 and 2000. Their paper analyzes fertility levels and changes, both nationally and comparatively between urban and rural settings. For some countries, they also examined current levels and changes in fertility at specific ages.

Through their research, Shapiro and Tambashe (2002) identified a three-stage transition process that the 15 countries they had multiple surveys for had experienced. The first stage is of overall relatively high fertility, where fertility is decreasing in urban areas but stable in rural areas. Next, both rural and urban fertility rates fall, with urban fertility still declining faster. Lastly, when the country reaches relatively low fertility rates, the rate of fertility is declining faster in rural areas than in urban places.

In my thesis, I will reexamine these issues with the newest data from the DHS. There are now many more surveys available, from more than double the number of countries (15 to 40 countries) and more than double the number of pairs of surveys (30 to 70 pairs). I will be looking to see if these new data support Shapiro and Tambashe's (2002) three-stage transition process theory. I will consider changes in national total fertility rates, fertility rates in rural versus urban areas, and differences between capital cities compared to other urban areas and rural areas. After I answer these questions, I will consider other factors, such as age-specific fertility rates and how they have changed in relation to countries' Total Fertility Rate.

Chapter 3

Methods

The data for this paper are from the Demographic and Health Surveys (DHS) Program. Its website can be located at http://dhsprogram.com/. The DHS Program is funded by the U.S. Agency for International Development (USAID). It studies many countries and collects data on a wide variety of different topics, including population, health, and nutrition. The DHS aims to compile data that can be used to create and implement policy interventions. The DHS program established a standard model of data collection that they use across countries to ensure that information was collected in a consistent manner and the data reliable. The DHS program includes questionnaires from a representative sample of the population in different regions throughout sub-Saharan Africa. Specifically, between 5,000 and 30,000 households were surveyed in each country.

According to the DHS website, questionnaires ask several questions regarding fertility to obtain an accurate understanding of a woman's household:

> …Each woman is asked the number of sons and daughters who live with her, the number who live elsewhere, and the number who were born alive and later died… a complete history of all the woman's births is obtained… For dead children, the age at death is recorded… [And] information is collected on whether a woman was pregnant at the time of the survey (DHS Program).

The DHS surveys on fertility used for this paper were taken from 1986 to 2014. There are 110 surveys from 40 countries. In 30 of these countries, more than one survey was taken. In countries where more than one survey was taken, I was able to examine temporal changes, or changes over time within a country.

Chapter 4

Results

National Total Fertility Rate

Table 1 shows data on Total Fertility Rates (TFRs) on a national level and separately for rural areas, urban areas, and capital regions, when available, for each country. These data represent 40 countries in sub-Saharan Africa that the Demographic and Health Surveys (DHS) have covered. At the time of their paper, only 29 countries had data, thus Shapiro and Tambashe (2002) studied fewer countries. These data do not include Nigeria as one of the surveys was flawed. This paper will focus on 110 surveys, more than twice the number Shapiro and Tambashe (2002) studied. All data have been obtained from the DHS surveys via the STATcompiler.

First I will consider the overall national levels of fertility. They range from a low of 2.9 in South Africa from the 2006/07 survey to a high of 7.6 in 2012 in Niger. The average national fertility rate across sub-Saharan Africa is 5.02 as of the most recent surveys available. There is a standard deviation of .971, which means on average countries' fertility rates will vary by approximately 1 from the mean of 5.02. This is a relatively low standard deviation, so the data are less spread out between individual countries. This information is displayed in Figure 1.

As Shapiro and Tambashe (2002) explained in their original paper, South Africa is often an exception to fertility rules in sub-Saharan Africa. In 2002, the sub-Saharan African countries' national TFRs ranged from 3.1 to 7.5, thus the overall range has only slightly changed with the updated surveys from the past 10 years. Because South Africa is again the country with the lowest TFR and its fertility rates has been steadily declining over the past few decades, it makes

sense that the lowest TFR has only fallen slightly. Niger again is the country with the highest national TFR, and in 2012 its TFR actually rose by .6 since 2006.

The next lowest TFR is 3.3 in Lesotho in 2009. The second highest TFR is 7.4 in Uganda in the 1988/89 survey. Therefore, even if we were to exclude South Africa and Niger as outliers, the remaining countries still have a significant range of fertility rates.

In 2002, Shapiro and Tambashe found that 17 out of 49 surveys (34.7%) had a national TFR of 5.5 or less, 18 (36.7%) had a TFR from 5.5-6.5, and 14 (28.6%) had a TFR greater than 6.5. With the updated data in 2014, among the 110 surveys, it was found that 56 (51%) report a TFR of 5.5 or less, 37 surveys (34%) report a TFR from 5.5-6.5, and 17 (15%) have TFRs that are greater than 6.5. This information is displayed in Figure 2. Clearly, the countries surveyed are, in general, much further along in the fertility transition. By 2014, over half of all countries had fertility rates below 5.5, which is a significant increase from the 34.7% in 2002. The average national TFRs on the first survey across countries with multiple surveys available is 5.953. The average national TFR across these same surveys on the last completed survey was 5.189. This information is summarized in Table 2.

Next, we consider sub-Saharan Africa by its four major regions defined by geographic location (Southern, Northern, Middle, and Western Africa). As of the most recent surveys available, the average fertility in Western Africa (data available from Benin, Burkina Faso, Cape Verde, Cote d'Ivoire, Ghana, Guinea, Liberia, Mali, Mauritania, Niger, Nigeria, Senegal, Sierra Leone, and Togo) is 5.27. The average fertility in Middle Africa (data available from Cameroon, Chad, Congo (Brazzaville), Congo Democratic Republic, Gabon, and Sao Tome and Principe) is 5.3. The average fertility in Eastern Africa (data available from Burundi, Comoros, Eritrea, Ethiopia, Kenya, Madagascar, Malawi, Mozambique, Rwanda, Sudan, Tanzania, Uganda,

Zambia, and Zimbabwe) is 5.18. Southern Africa (data available from Botswana, Lesotho, Namibia, South Africa, and Swaziland) is 3.72. Southern Africa has fertility much lower than the other three regions. Western, Eastern, and Middle Africa have relatively similar fertility rates.

Rural and Urban Fertility Rates

In every case with pairs of surveys available, the estimated total fertility rates are lower in urban areas than in rural areas. The average difference between urban and rural fertility rates is 1.94, with the average rural TFR at 6.1 compared to an average of 4.2 in urban areas. In 2002, the difference was 1.8, where the average rural total fertility rate was 6.4 compared to an average of 4.6 for urban areas. In only eight cases out of the 110 surveys– Central African Republic (1994-95), Chad (1996), Liberia (1986), Mali (1987), Mozambique (1997), Niger (1992), Nigeria (1999) and Mauritania (2000/01) – is the difference less than 1.0. Seven out of eight of these were from surveys prior to 2001. The one survey studied after 2001 that has a difference less than 1.0 was in Mauritania in 2001. In 49 cases, the difference was greater than 2.0, compared to the surveys studied in 2002, where only 14 countries had differences greater than 2.0.

This information shows us several crucial facts. Again, both in 2014 and 2002, in the surveys available urban areas always have lower TFRs than rural areas. However, with the more recent surveys of the last decade, the difference between urban and rural areas has grown from 1.8 to 1.94. In the last decade, both rural and urban TFRs have fallen (from 6.4 to 6.1 and 4.6 to 4.2, respectively). Not only are urban TFRs lower, they have also fallen more in the past 10

years, by .4 compared to .3 in rural areas. Thus on average, urban fertility is 31 percent lower than rural fertility for all surveys taken together. In 2002, urban fertility was 28 percent lower.

Capital City/Region Fertility Rates

Information on the capital city was available for 89 out of 110 surveys. In these surveys, the total fertility rate was always lower in the capital city than the national TFR. Among these 89 surveys, the mean difference in total fertility rate between the national and capital region was 1.6. In 2002, information was only available on the capital region's fertility rates in 27 of the surveys. In 2002 for the surveys available, the average difference between capital and national TFRs was 1.8, so the difference between capital and national TFRs is shrinking. In 2014, national TFRs averaged 5.5 and capital TFRs averaged 3.9. In 2002, the national TFRs averaged 5.88 and capital TFRs averaged 4.1. Both national and capital TFRs have fallen, but national TFRs are falling faster (a decline of .38 compared to .2).

It is also interesting to compare fertility rates in the capital city or region to all urban areas in the country. In 2014, the capital cities had fertility levels that were .29 lower on average than in all urban areas. Fertility is lower in capital areas than in all urban areas, but not significantly lower. The difference would be higher if you excluded the capital city from this average.

Changes in Fertility over Time

Of the 40 countries for which there are surveys available, 30 countries have multiple surveys from different years. There are 70 pairs. A pair can be defined as two surveys from the same country where either one directly precedes or follows the other chronologically. The duration between pairs of surveys among these countries ranges from 2 years to 23 years, with an average of 6.5. By examining pairs of surveys, we can consider changes in fertility over time nationally and by place of residence (capital, urban, or rural area). In absolute terms, fertility decline is in general greater in less developed regions than in more developed regions. This could be due to the fact that the original TFRs were significantly higher in less developed regions, and thus they have more room for declines. However, the fertility decline has been faster in Asia and Latin America than in sub-Saharan Africa.

Tables 3, 4, 5, and 6 depict where national, urban, and rural fertility rates have declined or stalled between countries that have multiple surveys. A country is defined as "stalling" when the TFR in the more recent survey in a consecutive pair is not lower than the TFR in the previous survey. In Table 4, we can see the frequency of stalling organized by overall, rural, and urban area for each country.

Table 5 depicts the number of pairs that experienced stalling in national, urban, and rural fertility rates. In all cases, the majority of pairs did not experience stalling. Countries experienced stalling in national TFRs less often than in rural and urban areas. Stalling occurs more often in urban areas than in rural area. According to the 2014 data, 31 percent of pairs experienced stalling in rural areas. In 2002, Shapiro and Tambashe found that stalling never

occurred in urban areas in the pairs available. Comparatively, stalling of urban fertility decline did occur in 36 percent of pairs according to the 2014 data.

In Table 6, we consider the temporal dimension of stalling versus declining. Pairs were broken into three groups: from the 1980s-1990s, 1990s-2000s, and 2000s-2010s. National Total Fertility Rates never stalled when considering pairs from the 1980s-1990s. It stalls more frequently with pairs from the 90s-00s. Rural fertility rates also most often stalled from 90s-00s. However, urban fertility rates stalled most often from the 00s-10s. Overall, stalling is most frequent in the pairs from the 00s-10s, but only by 1. The earlier stalling in rural areas suggests a weaker fertility decline in these areas. On the other hand, the more frequent later stalling of urban transitions suggests that fertility decline could be bumping into desired family size floors. In fertility transitions in other parts of the world, it has been found that declines tend to be very slow once fertility reaches a certain low level, in some cases 2 children per woman. This can be thought of as a target level of fertility, or a floor, below which fertility would not fall (United National Population Division, 2002). This is apparent in the capital city of the Democratic Republic of the Congo, Kinshasa, where stalling is significant from the 2013-2014 DHS survey.

Tables 7 and 8 aggregate the pairs into several different groups, depending on the initial national TFR in the pair. Table 7 was first created to study the changes between pairs according to the level of fertility in the first survey of the pair. The groupings in Table 7 were replicated from Table 2 in Shapiro and Tambashe's (2002) original paper with the updated surveys that were released since the publishing of their paper. This table allows for consideration of changes on the national level and in rural and urban areas.

In all cases, urban fertility declines the most, followed by national fertility and then by rural fertility rates. Table 7 found that when the initial national TFR was greater than 6.5,

national TFR fell by 5 percent, rural by 3 percent, and urban by 11 percent. When the initial national TFR was between 5.5 and 6.5, national TFR fell by 6 percent, rural by 4 percent, and urban by 9 percent. When the initial national TFR was less than 5.5, national TFR fell by 5 percent, rural by 4 percent, and urban by 6 percent. According to this information, urban fertility rates fall the most when the original fertility rate in the first survey is relatively high (in the 6.5 or greater group). Urban rates fall slowest when the TFR in the original pair was relatively low (in the 5.5 or less group), and pairs whose original survey's TFR falls between 5.5 and 6.5 are in the middle.

This finding is consistent with the beginning of what Shapiro and Tambashe (2002) describe as a three-stage transition pattern. They describe this transition as:

> … A three-stage transition pattern in which overall fertility decline begins slowly and then accelerates. In the initial stage, with overall fertility quite high, rural fertility is more or less stable while urban fertility declines. Subsequently, both urban and rural fertility decline, with the decreases in the former being clearly larger than those in the latter. And finally, when a comparatively low overall level of fertility has been reached, the pace of continued fertility decline appears to be as great or greater in rural than in urban areas. (p. 114)

This is consistent with the information in Table 7. Countries whose initial national TFRs are below 5.5 have still not quite reached this last stage, where rural fertility decline is equal to or greater than the decline in urban areas. However, the relative decline in fertility in urban and rural areas is very close; urban areas have fertility rates declining by 6 percent and rural areas are declining by 4 percent. Consistent with the three-stage theory, the differences between rural and urban areas narrow as the original TFR is lower.

Table 8 reviews the same data as Table 7, but with groups divided at different cut-off points. Table 8 potentially calls into question the accuracy of the results from Table 7, and thus Shapiro and Tambashe's (2002) original findings and conclusion of a three-stage transition. Because the groupings in Table 7 were created somewhat arbitrarily, it was important to create different groupings and change the cut-off points between TFR categories to see if this influences the results. Because overall TFRs have been going down since Shapiro and Tambashe's (2002) original table, the groups were divided differently to create a fourth category for pairings whose original national TFR is less than 4. In Table 8, in the high-fertility group the relative urban decline is 3 times as large as the relative rural decline.

In Table 7, it was found that in the countries with pairs of surveys available, urban fertility always declines the most, regardless of initial national TFR, followed by national TFR, and then rural fertility rates. However, Table 8 shows that in pairs where the original TFR was less than 4, fertility actually increases in urban and rural areas, although national fertility declines by 3%. This is not consistent with the three-stage theory. However, for pairs whose original national TFR is between 4 and 5, urban fertility rates are steady and rural rates decline by 2%. This does appear to be consistent with the third stage in the three-stage transition process, where low overall fertility rates have been reached, and the pace of decline is greater in rural areas than in urban areas. One possible explanation for the fact that declines are stalling could be that have reached the desired family size "floor" discussed above, where in urban areas, fertility is 3.3, which could be the desired number of children. We cannot confirm this hypothesis without information about desired family sizes for sub-Saharan African families. For pairings whose original national TFR is between 5 and 6 or greater than 6, fertility declines significantly faster in

urban areas than in rural areas, although rural fertility rates are falling. These countries could again be described as in the second stage of transition.

There are some inconsistencies between Tables 7 and 8. Because these two tables depict the same data but when analyzed lead to some different results, we must consider the accuracy of either conclusion. However, Shapiro and Tambashe's (2002) original paper focuses on urban and rural fertility rates, and does not consider national. The only major difference between Tables 7 and 8 is the fact that for countries where the original TFR was less than 4, fertility increased. This could be due to the fact that there are not many countries in this group. Consistent increases in fertility have not been seen in any other demographic transition, so this would likely not continue as more countries reach these low levels of fertility. If these countries have indeed reached a desired family size "floor", you could expect continued stalling in the future, however. Therefore, although there are some differences between the results, they are overall strong enough to help confirm a three-stage transition process.

Age-Specific Fertility Rates

Lastly, I will consider the changes in age-specific fertility rates (ASFR) in sub-Saharan Africa. Age-specific fertility rates can be defined as the number of births in a year to women in a specific age group for every 1000 women in that age group (Age-Specific Fertility Rate, 2008). This statistic is useful when comparing fertility at different ages and changes over time across age groups. The data I used from the DHS surveys breaks up fertility rates into 7 age ranges: 15-19, 20-24, 25-29, 30-34, 35-39, 40-44, and 45-49. Fertility is relatively uncommon before age 15 and after age 49, so this data were not considered.

In Figure 3, we can see age-specific fertility rates in the first survey in each of the available pairs and the last survey available for all of the countries in sub-Saharan Africa. One point to keep in mind with this information is that the time between the first and last survey varies between countries. The oldest surveys were taken between 1986 and 2008 and the newest surveys were taken between 1998 and 2013-4. The time between the surveys varies from 5 to 27 years. The average length between the first and last surveys is 15.875 years. Although the difference in time between surveys is not the same across every country, we can compare how age-specific fertility rates have changed over time. With the exception of a few outliers, the first and last surveys generally look at ASFR between the 1990s and the 2000s and 2010s.

There are several trends concerning age and fertility that are consistent across time. Fertility begins low for women who are ages 15-19. Fertility increases as women age until peaking at ages 25-29. It then decreases continuously until menopause.

From Figure 3, we can clearly see that fertility decreased from the first and last DHS survey for all age groups. However, how much fertility fell is not consistent for every age group. The differences in declines between age groups are displayed in Figure 4. Between ages 20-34, the changes fertility are greatest: fertility drops 27.3-25.2 births per 1000 women. Fertility falls less for women younger than 20 or older than 34. In other words, fertility rates have stayed more stable for women younger than 20 or older than 34 than for women 20-34.

In the next eight figures, I considered age-specific fertility rates broken up by each region in sub-Saharan Africa for the countries for which I had at least two surveys: Western Africa (Benin, Burkina Faso, Cote d'Ivoire, Ghana, Guinea, Liberia, Niger, Senegal, Mali, Nigeria, Sierra Leone, Togo), Middle Africa (Cameroon, Chad, Congo (Brazzaville), Congo Democratic Republic, Gabon), Eastern Africa (Burundi, Comoros, Eritrea, Ethiopia, Kenya, Madagascar,

Malawi, Mozambique, Rwanda, Tanzania, Uganda, Zambia, Zimbabwe), and Southern Africa (Lesotho, Namibia). It is important to note that these graphs only include countries with at least two surveys available. Therefore, these graphs may not be representative of the entire region. Differences between regions could be explained by several things. Cultural and political differences may play a role in changing fertility. In addition, if regions are at different stages in the demographic transition, they may see fertility falling faster in different age groups.

In Figures 5 and 6, we see that Western Africa's ASFRs in the first and last survey are both similar to those of the average of all sub-Saharan Africa. However, fertility changed very little in Western Africa between the first and last survey. In particular, peak fertility, ages 25-29, only fell by .8 births per 1000. In other age ranges, fertility fell approximately half as much as it did on average in sub-Saharan Africa. This is particulary suprising given Western Africa's relatively high life expectancy, relative to all of sub-Saharan Africa (Tyler and Gopal, 2010). Although fertility did fall somewhat for all age ranges, it did not fall as quickly as one would expect.

Figures 7 and 8 display age-specific fertility rates in Middle Africa according to the first and last surveys available in this region. It is worth mentioning that at least two surveys were only available for five countries in Middle Africa. There are 10 countries total in this region. As in Western Africa, fertility fell at much slower rates in Middle Africa when compared to the average in sub-Saharan Africa. In fact, fertility actually increased for some age groups. However, there is a logical explanation for this fact. In the first surveys, peak fertility in this region was between ages 20-24. By the time of the last surveys, women were having children later in life: peak fertility changed to ages 25-29. So, the amount that fertility increased from ages 25-29 and 30-34 (6.4) is less than the amount fertility fell from ages 20-24 (14). In other words, the fact that

some women had children later accounts for some of the decrease in children, and the demographic transition may account for the rest of it. Another interesting point to note is that for three of the countries in this region, both the first and last surveys were after 2000, which is recent relative to all of the surveys available. Their fertility rates at the time of the last survey were lower in almost all age ranges than in the aggregate sub-Saharan Africa calculation.

In Eastern Africa, displayed in Figures 9 and 10, fertility fell for all age ranges. It fell at very high rates relative to the rest of sub-Saharan Africa. Fertility for the region fell most in two of the age ranges where fertility was highest (25-29 and 30-34). However, by the time of the second survey, peak fertility changed from ages 25-29 to 20-24, meaning individuals had children earlier in life. This could be because fertility did not fall as much in this age range as it did for those aged 25-29. This information is surprising given the fact that as countries develop, women typically have children later in life.

Lastly, the DHS had at least two surveys on two countries in Southern Africa and this information is displayed in Figures 11 and 12. There are 5 countries total in Southern Africa. This data did not include South Africa, which is considered one of the more economically developed countries in sub-Saharan Africa and which dominates population in Southern Africa. This region overall has lower fertility rates than the average across sub-Saharan Africa. In other words, they are presumably farther along in the fertility transition than the rest of sub-Saharan Africa. The trends in Southern Africa are somewhat similar to the trends in all of sub-Saharan Africa. Southern Africa had larger declines from ages 25-44. Fertility fell between the first and last surveys and fell the most where initial fertility was highest. Fertility rates dropped most significantly in the 25-29 age range and the 35-39 age range. Peak fertility age range surprisingly changed between the two surveys from 25-29 to 20-24. Typically as countries progress

economically, average age at marriage, and thus age of childbearing, increases. This is not the case in Southern Africa, however.

The fact that there was such a wide variety of results across regions calls into question some conclusions I drew about overall age-specific fertility transitions in sub-Saharan Africa. One possible explanation for this could be difference in Gross Domestic Product (GDP) per capita across regions. The GDP per capitas for each country that was studied for ASFR is found in Table 9. Of the countries survied, Middle Africa has the highest GDP per capita in US dollars at $3,520.92. Southern Africa is a close second at $3,409.35. Westen and Eastern Africa are both significantly lower, with GDP per capitas of $1,029.36 and $721.12. Again, these numbers may not be representative of the entire regions, as they only include countries for which several surveys were available. The fact that Southern Africa has a relatively high GDP per capita is consistent with the finding that their fertility rates are relatively low. Eastern Africa, despite having the lowest GDP per capita, saw relatively high declines in fertility between the first and last survey. Western Africa has a relatively low GDP per capita, and their fertility rates have changed very little between the first and last survey.

Some trends were relatively consistent throughout sub-Saharan Africa: fertility did fall between the two surveys, fertility fell most at the highest levels of fertlity (between ages 20-34), and did not fall as much at very young or old ages. However, due to inconsistencies between regions, the overall ASFR for sub-Saharan Africa seems to find an average of each region, which may not truly be representative of sub-Saharan Africa as a whole and is not an effective predicter for the entire region. As noted earlier, Western, Eastern, and Middle Africa have similar total fertility rates at the time of the second survey, with Southern Africa significantly lower. What varies greatly between these regions is how and when the fertility changed between the first and

last survey. Although we can make observations about specific regions of sub-Saharan Africa, with the given data it is difficult to generalize many trends of changes in age-specific fertiltiy transitions for the entire continent.

Chapter 5

Conclusion

Based on the data and information above, I confirm Shapiro and Tambashe's (2002) original hypothesis of a three-stage fertility transition in sub-Saharan Africa. Urban fertility rates are falling the most significantly when national TFRs were originally high in the first survey. Urban fertility falls slower when the original TFR was already low. Overall, rural fertility decline is still not quite equal to urban. However, for countries whose original TFR was less than 5.5, rural decline is very close to urban decline. In other words, as overall national fertility rates fall, the differences between rural and urban TFR is narrowing. National TFRs are declining faster than fertility rates in capital areas, but capitals fertility rates are already lower. This is consistent with the three-stage hypothesis. Urban rates fall first and at relatively high rates. I predict that rural fertility decline will eventually surpass urban decline. I believe at a certain point urban areas will reach desired family size floors. Rural areas are still far away from reaching these floors.

The data regarding age-specific fertility rates are less conclusive. In general, women experience the greatest decline in fertility between ages 20-29. This could be due in part to the fact that women are having children later in life. The significant differences between the regions within sub-Saharan Africa make it difficult to generalize for the entire continent, however. Economic, political, and social differences between North, East, South, and Middle Africa have led to differences between fertility decline, and specifically at what ages fertility is falling the fastest.

Fertility rates fall faster in urban areas in part because industrialization affords more employment opportunities for women, increasing the cost of children. Despite issues such as AIDS and war throughout the region, sub-Saharan Africa has begun to experience mortality and fertility decline. Future research should continue to focus on areas that have seen the greatest declines in fertility. As discussed earlier, two reasons for falling fertility rates are increased women's educational attainment and decreased infant and child mortality rates. Therefore, working to continue to increase educational opportunities for women and healthcare for infants and children will indirectly help to decrease fertility. If we can determine additional reasons why certain countries are experiencing the most rapid decline, we can attempt to continue the spread of decline to the rest of the region. For the continued economic development of sub-Saharan Africa, it is vital that they experience additional fertility decline. If we can determine additional, controllable factors, such as family planning programs, are effective in lowering fertility rates, it would be beneficial to continue to implement these programs through the region. Further research should focus on the potential barriers to these types of programs and evaluating their effectiveness and efficiency.

Appendix A
Figures

Figure 1. Frequency Distribution of TFRs, Most Recent Survey

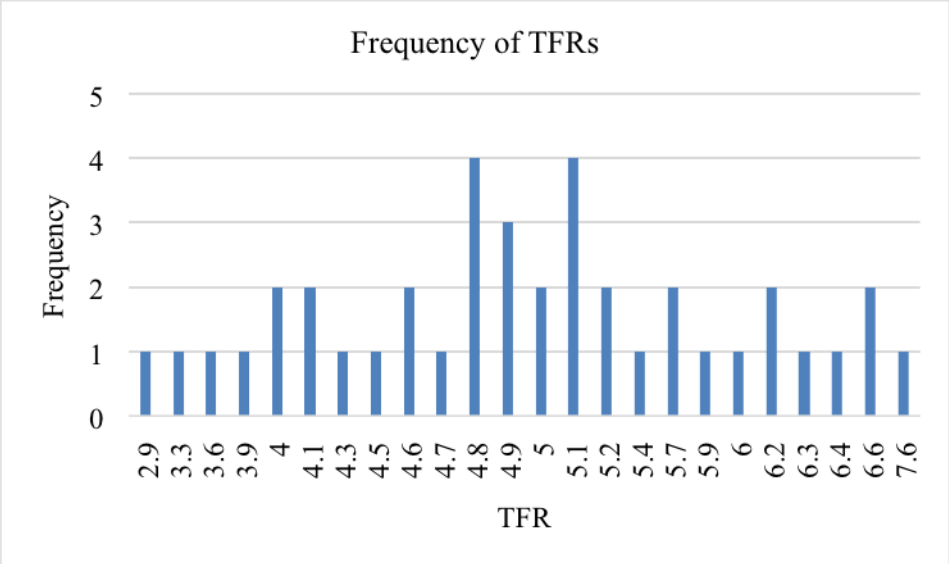


Figure 2. Distribution of Fertility in sub-Saharan African Countries

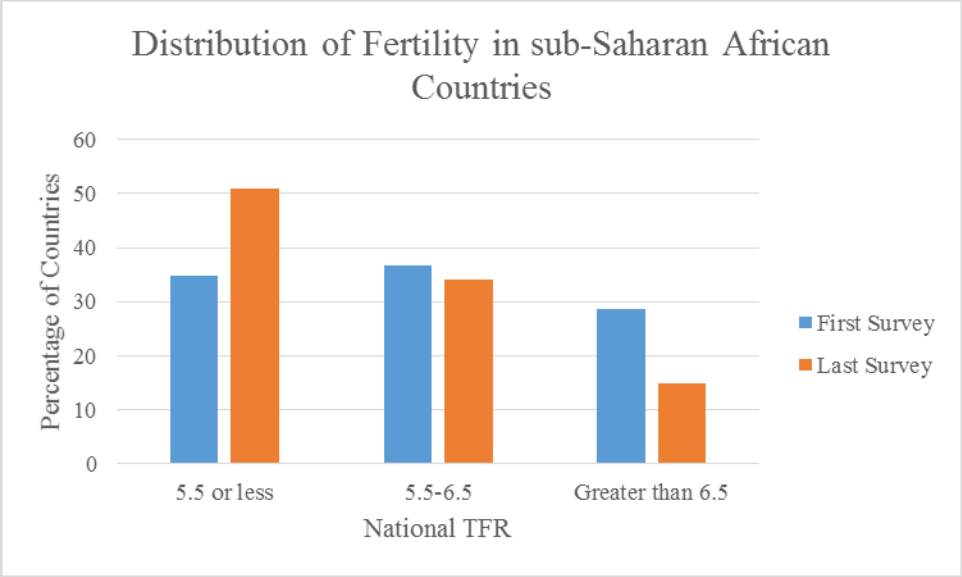


Figure 3. Age-Specific Fertility in sub-Saharan Africa

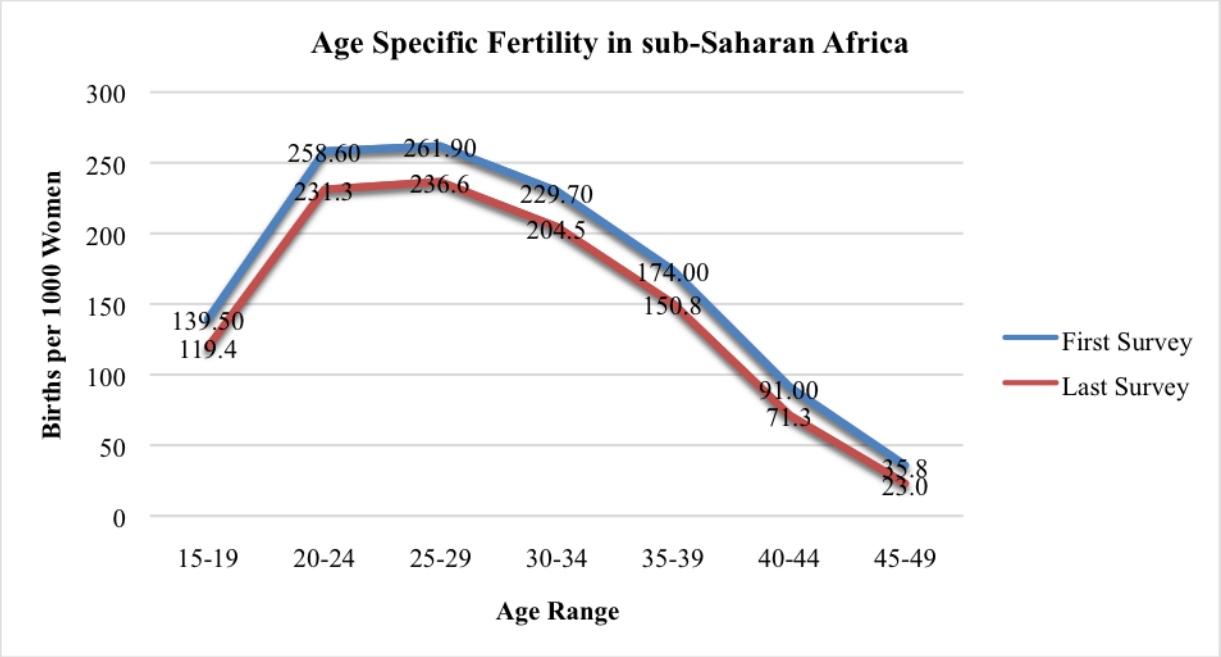


Figure 4. Declines in ASFR in sub-Saharan Africa Between First and Last Survey

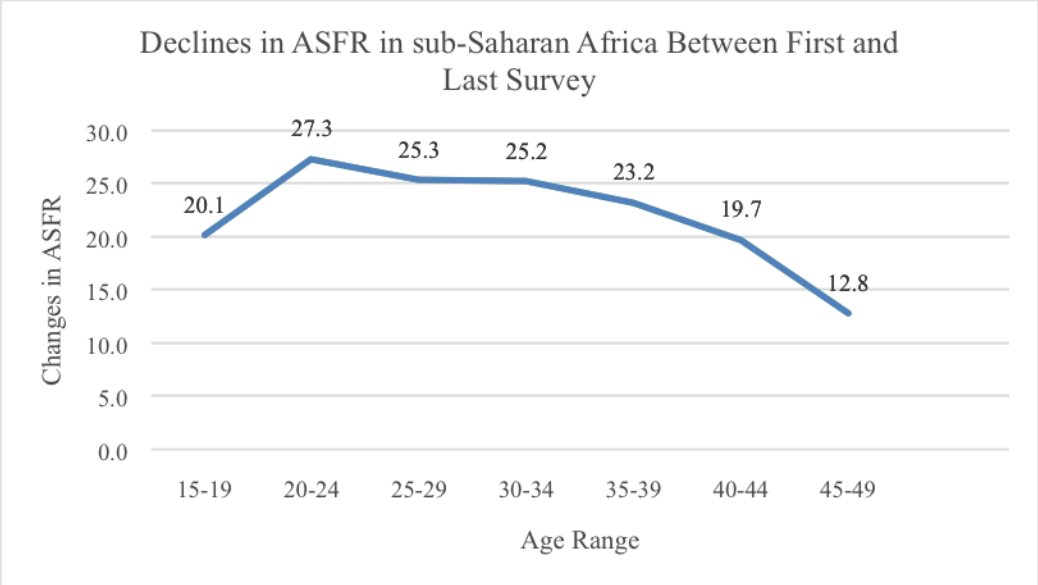


Figure 5. Age-Specific Fertility in Western Africa

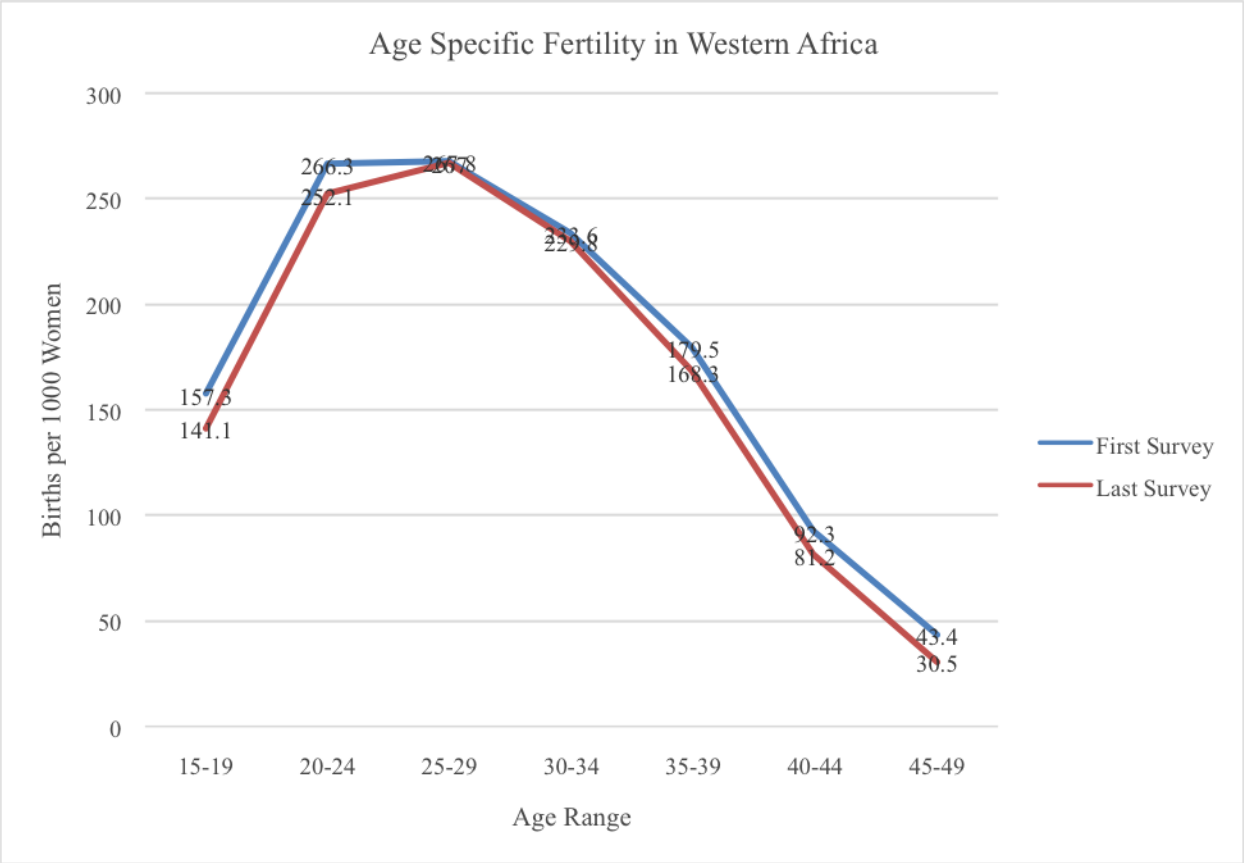


Figure 6. Declines in ASFR in Western Africa Between First and Last Survey

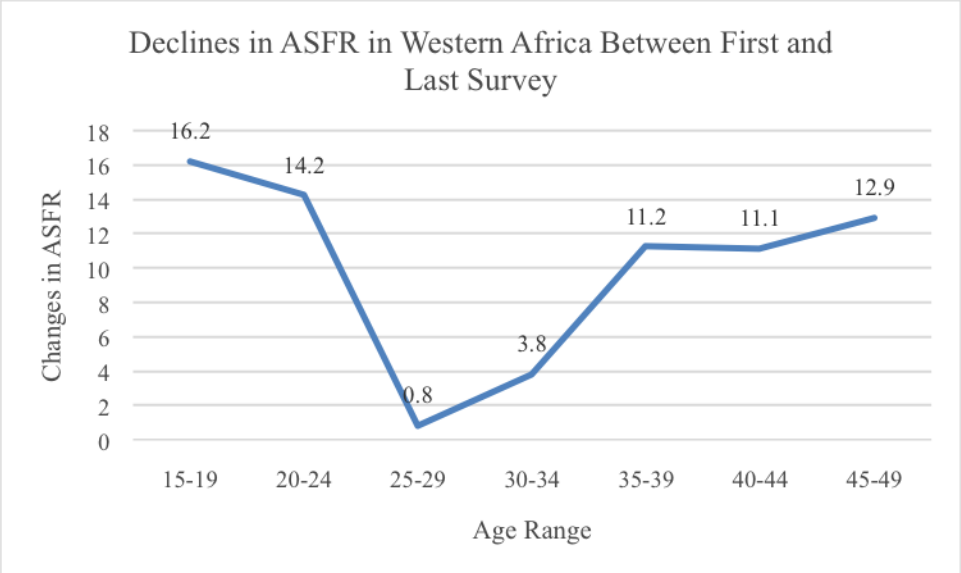


Figure 7. Age-Specific Fertility in Middle Africa

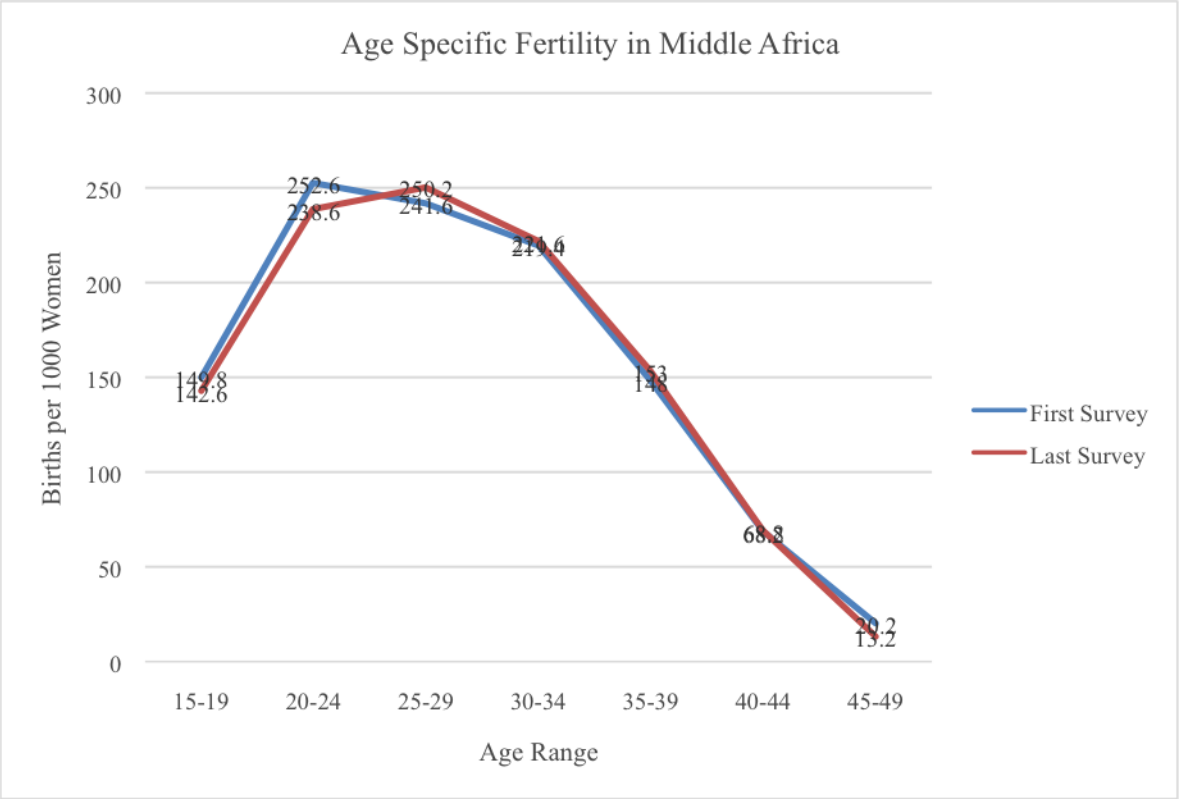


Figure 8. Declines in ASFR in Middle Africa Between First and Last Survey

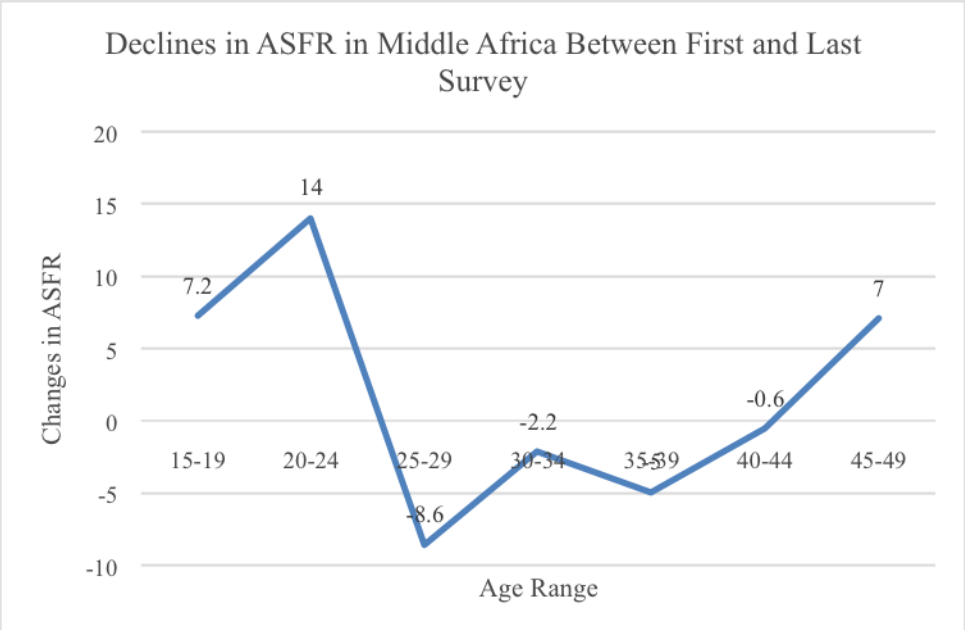


Figure 9. Age-Specific Fertility in Eastern Africa

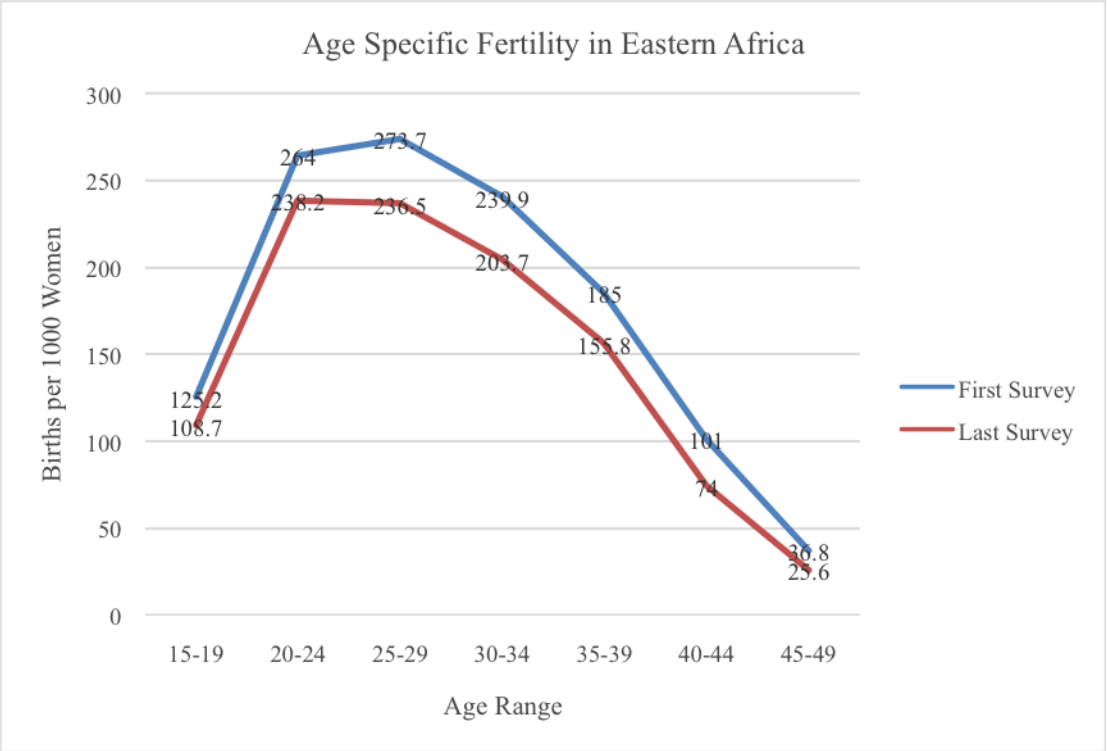


Figure 10. Declines in ASFR in Eastern Africa Between First and Last Survey

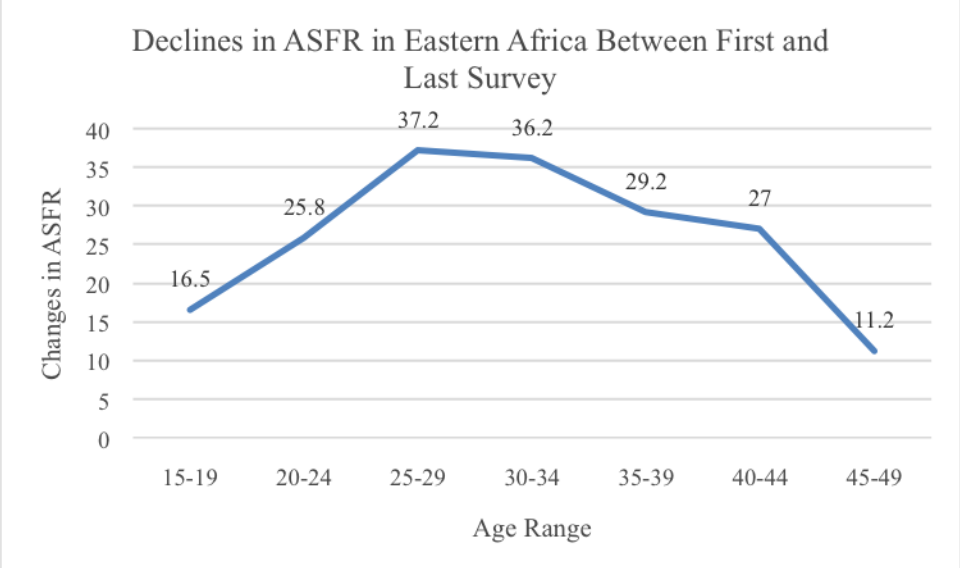


Figure 11. Age-Specific Fertility in Southern Africa

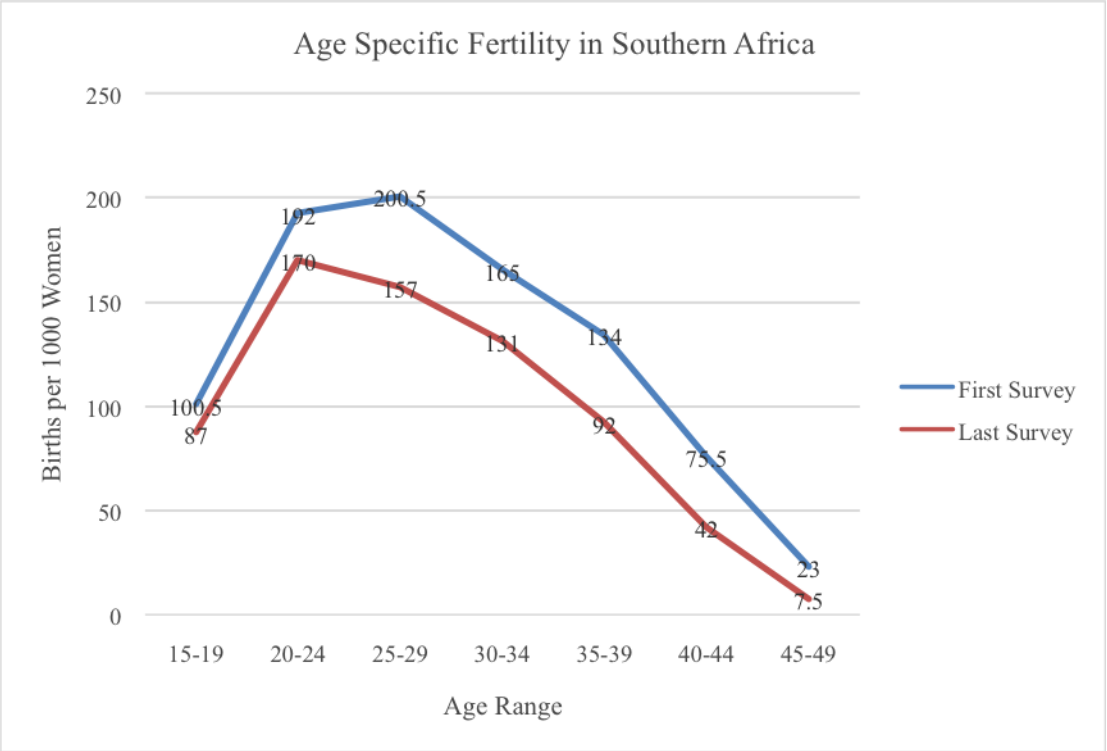
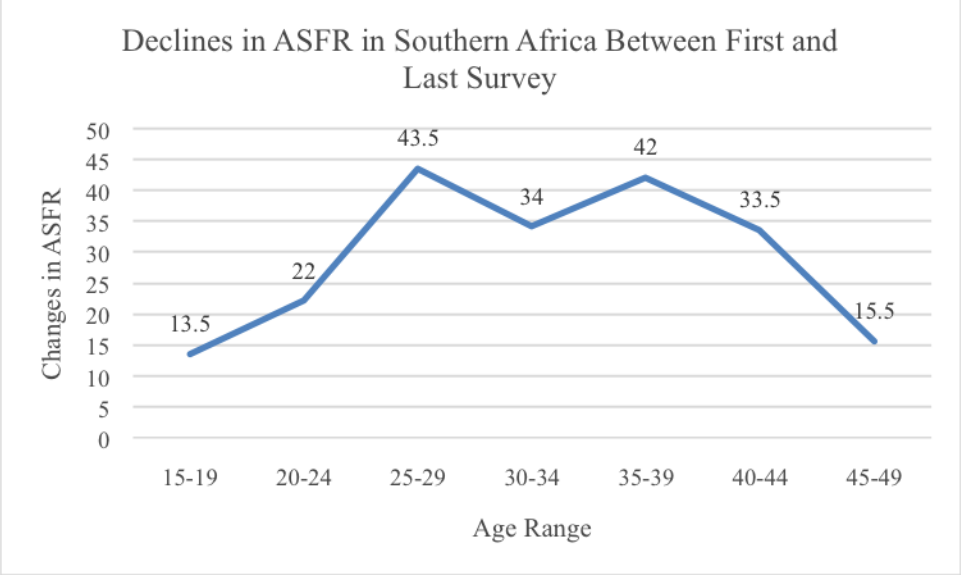


Figure 12. Declines in ASFR in Southern Africa Between First and Last Survey



Appendix B

Tables

Table 1. Total Fertility Rates: National, Rural, Urban, and Capital Regions

Country (Year of Survey)	National TFR	Rural	Urban	Capital City/Region
Benin (1996)	6	6.7	4.9	-
Benin (2001)	5.6	6.4	4.4	3.4
Benin (2006)	5.7	6.3	4.9	3.7
Benin (2011/12)	4.9	5.4	4.3	3.6
Burkina Faso (1993)	6.5	7	4.6	4.2
Burkina Faso (1998/99)	6.4	6.9	3.9	4
Burkina Faso (2003)	5.9	6.5	3.4	2.8
Burkina Faso (2010)	6	6.7	3.9	3.4
Cape Verde (1998)	4	4.8	3.1	4
Cote d'Ivoire (1994)	5.3	6	4.4	3.7
Cote d'Ivoire (1998/99)	5.2	6	4	3.4
Cote d'Ivoire (2011/12)	5	6.3	3.7	3.1
Ghana (1988)	6.4	7	5.3	4.7
Ghana (1993)	5.2	6	3.7	3.4
Ghana (1998)	4.4	5.3	3	2.7
Ghana (2003)	4.4	5.6	3.1	2.9
Ghana (2008)	4	4.9	3.1	2.5
Guinea (1999)	5.5	6.1	4.4	-
Guinea (2005)	5.7	6.3	4.4	4.1
Guinea (2012)	5.1	5.8	3.8	3.6
Liberia (1986)	6.7	7.1	6	-
Liberia (2007)	5.2	6.2	3.8	3.4
Mali (1987)	7.1	7.4	6.3	5.6
Mali (1995/96)	6.7	7.3	5.4	4.7
Mali (2001)	6.8	7.3	5.5	4.9
Mali (2006)	6.6	7.2	5.4	4.8
Mauritania (2000/01)	4.5	4.8	4.1	4.2
Niger (1992)	7	7.1	6.4	5.5
Niger (1998)	7.2	7.6	5.6	5
Niger (2006)	7	7.3	6.1	5.4
Niger (2012)	7.6	8.1	5.6	5.3
Nigeria (1990)	5	6.5	6.3	-
Nigeria (2003)	5.7	6.1	4.9	-

Senegal (1986)	6.4	7.1	5.4	-
Senegal (1992/93)	6	6.7	5.1	-
Senegal (1997)	5.7	6.7	4.3	-
Senegal (2005)	5.3	6.4	4.1	3.7
Senegal (2010/11)	5	6	3.9	3.7
Sierra Leone (2008)	5.1	5.8	3.8	3.4
Togo (1998)	5.2	6.3	3.2	2.7
Cameroon (1991)	5.8	6.3	5.2	4.4
Cameroon (1998)	4.8	5.4	3.8	3
Cameroon (2004)	5	6.1	4	3.2
Cameroon (2011)	5.1	6.4	4	3.3
Central African Republic (1994/95)	5.1	5.2	4.9	4.7
Chad (1996/97)	6.4	6.5	5.9	5.5
Chad (2004)	6.3	6.5	5.7	5.8
Congo (Brazzaville) (2005)	4.8	6.1	3.8	3.6
Congo Democratic Republic (2007)	6.3	7	5.4	3.7
Congo Democratic Republic (2013/14)	6.6	7.3	5.4	4.2
Gabon (2000)	4.2	6	3.8	3.4
Gabon (2012)	4.1	6.1	3.9	3.5
Sao Tome and Principe (2008/09)	4.9	5.5	4.4	4.6
Burundi (1987)	6.9	7	5.1	-
Burundi (2010)	6.4	6.6	4.8	4.2
Comoros (1996)	4.6	5	3.8	3.8
Comoros (2012)	4.3	4.8	3.5	3.5
Eritrea (1995)	6.1	7	4.2	4.4
Eritrea (2002)	4.8	5.7	3.5	3.4
Ethiopia (2000)	5.5	6	3	-
Ethiopia (2005)	5.4	6	2.4	-
Ethiopia (2011)	4.8	5.5	2.6	1.5
Kenya (1989)	6.7	7.1	4.5	4.2
Kenya (1993)	5.4	5.8	3.4	3.4
Kenya (1998)	4.7	5.2	3.1	2.6
Kenya (2003)	4.9	5.4	3.3	2.7
Kenya (2008/09)	4.6	5.2	2.9	2.8
Madagascar (1992)	6.1	6.7	3.8	5.7
Madagascar (1997)	6	6.7	4.2	5.4
Madagascar (2008/09)	4.8	5.2	2.9	4.2
Malawi (1992)	6.7	6.9	5.5	-

Malawi (2000)	6.3	6.7	4.5	-
Malawi (2004)	6	6.4	4.2	-
Malawi (2010)	5.7	6.1	4	-
Mozambique (1997)	5.2	5.3	4.6	3.7
Mozambique (2003)	5.5	6.1	4.4	3.2
Mozambique (2011)	5.9	6.6	4.5	3.1
Rwanda (1992)	6.2	6.3	4.5	-
Rwanda (2000)	5.8	5.9	5.2	4.9
Rwanda (2005)	6.1	6.3	4.9	4.3
Rwanda (2007/08)	5.5	5.7	4.7	4.4
Rwanda (2010)	4.6	4.8	3.4	3.5
Sudan (1989/90)	4.7	5.3	3.9	3.7
Tanzania (1992)	6.2	6.6	5.1	5.3
Tanzania (1996)	5.8	6.3	4.1	4.3
Tanzania (1999)	5.6	6.5	3.2	-
Tanzania (2004/05)	5.7	6.5	3.6	3.6
Tanzania (2010)	5.4	6.1	3.7	3.9
Uganda (1988/89)	7.4	7.6	5.7	5.7
Uganda (1995)	6.9	7.2	5	5
Uganda (2000/01)	6.9	7.4	4	4
Uganda (2006)	6.7	7.1	4.4	3.7
Uganda (2011)	6.2	6.8	3.8	3.3
Zambia (1992)	6.5	7.1	5.8	5.5
Zambia (1996)	6.1	6.9	5.1	4.9
Zambia (2001/02)	5.9	6.9	4.3	4.3
Zambia (2007)	6.2	7.5	4.3	4.1
Zimbabwe (1988)	5.4	6.2	3.8	3.9
Zimbabwe (1994)	4.3	4.9	3.1	2.8
Zimbabwe (1999)	4	4.6	3	3
Zimbabwe (2005/06)	3.8	4.6	2.6	2.5
Zimbabwe (2010/11)	4.1	4.8	3.1	3.1
Botswana (1988)	4.9	5.3	3.8	-
Lesotho (2004)	3.5	4.1	1.9	2.5
Lesotho (2009)	3.3	4	2.1	2.7
Namibia (1992)	5.4	6.3	4	-
Nambia (2000)	4.2	5.1	3.1	3.4
Nambia (2006/07)	3.6	4.3	2.8	2.6
South Africa (1998)	2.9	3.9	2.3	-
Swaziland (2006/07)	3.9	4.2	3	-

Table 2. Distribution of Surveys of National TFR

2002 Data	Number of Surveys	Percentage
TFR 5.5 or less	17	35%
TFR 5.5-6.5	18	37%
TFR Greater than 6.5	14	29%
Total	49	100%

2014 Data	Number of Surveys	Percentage
TFR 5.5 or less	56	51%
TFR 5.5-6.5	37	34%
TFR Greater than 6.5	17	15%
Total	110	100%

Table 3. Trends in Total, Rural, and Urban Fertility

Country (Year of Survey)	Trend in National TFR	Trend in Rural Fertility	Trend in Urban Fertility
Benin (1996)	-	-	-
Benin (2001)	Decline	Decline	Decline
Benin (2006)	Stall	Decline	Stall
Benin (2011/12)	Decline	Decline	Decline
Burkina Faso (1993)	-	-	-
Burkina Faso (1998/99)	Decline	Decline	Decline
Burkina Faso (2003)	Decline	Decline	Decline
Burkina Faso (2010)	Stall	Stall	Stall
Cape Verde (1998)	-	-	-
Cote d'Ivoire (1994)	-	-	-
Cote d'Ivoire (1998/99)	Decline	Stall	Decline
Cote d'Ivoire (2011/12)	Decline	Decline	Decline
Ghana (1988)	-	-	-
Ghana (1993)	Decline	Decline	Decline
Ghana (1998)	Decline	Decline	Decline
Ghana (2003)	Stall	Stall	Stall
Ghana (2008)	Decline	Decline	Stall
Guinea (1999)	-	-	-
Guinea (2005)	Stall	Stall	Stall

Guinea (2012)	Decline	Decline	Decline
Liberia (1986)	-	-	-
Liberia (2007)	Decline	Decline	Decline
Mali (1987)	-	-	-
Mali (1995/96)	Decline	Decline	Decline
Mali (2001)	Stall	Stall	Stall
Mali (2006)	Decline	Decline	Decline
Mauritania (2000/01)	-	-	-
Niger (1992)	-	-	-
Niger (1998)	Pretransitional	Pretransitional	Decline
Niger (2006)	Pretransitional	Pretransitional	Stall
Niger (2012)	Pretransitional	Pretransitional	Decline
Nigeria (1990)	-	-	-
Nigeria (2003)	Stall	Decline	Decline
Senegal (1986)	-	-	-
Senegal (1992/93)	Decline	Decline	Decline
Senegal (1997)	Decline	Stall	Decline
Senegal (2005)	Decline	Decline	Decline
Senegal (2010/11)	Decline	Decline	Decline
Sierra Leone (2008)	-	-	-
Togo (1998)	-	-	-
Cameroon (1991)	-	-	-
Cameroon (1998)	Decline	Decline	Decline
Cameroon (2004)	Stall	Stall	Stall
Cameroon (2011)	Stall	Stall	Stall
Central African Republic(1994/95)	-	-	-
Chad (1996/97)	-	-	-
Chad (2004)	Decline	Stall	Decline
Congo (Brazzaville) (2005)	-	-	-
Congo Democratic Republic (2007)	-	-	-
Congo Democratic Republic (2013/14)	Stall	Stall	Stall
Gabon (2000)	-	-	-
Gabon (2012)	Decline	Stall	Stall
Sao Tome and Principe (2008/09)	-	-	-
Burundi (1987)	-	-	-
Burundi (2010)	Decline	Decline	Decline

Comoros (1996)	-	-	-
Comoros (2012)	Decline	Decline	Decline
Eritrea (1995)	-	-	-
Eritrea (2002)	Decline	Decline	Decline
Ethiopia (2000)	-	-	-
Ethiopia (2005)	Decline	Stall	Decline
Ethiopia (2011)	Decline	Decline	Stall
Kenya (1989)	-	-	-
Kenya (1993)	Decline	Decline	Decline
Kenya (1998)	Decline	Decline	Decline
Kenya (2003)	Stall	Stall	Stall
Kenya (2008/09)	Decline	Decline	Decline
Madagascar (1992)	-	-	-
Madagascar (1997)	Decline	Stall	Stall
Madagascar (2008/09)	Decline	Decline	Decline
Malawi (1992)	-	-	-
Malawi (2000)	Decline	Decline	Decline
Malawi (2004)	Decline	Decline	Decline
Malawi (2010)	Decline	Decline	Decline
Mozambique (1997)	-	-	-
Mozambique (2003)	Stall	Stall	Decline
Mozambique (2011)	Stall	Stall	Stall
Rwanda (1992)	-	-	-
Rwanda (2000)	Decline	Decline	Stall
Rwanda (2005)	Stall	Stall	Decline
Rwanda (2007/08)	Decline	Decline	Decline
Rwanda (2010)	Decline	Decline	Decline
Sudan (1989/90)	-	-	-
Tanzania (1992)	-	-	-
Tanzania (1996)	Decline	Decline	Decline
Tanzania (1999)	Decline	Stall	Decline
Tanzania (2004/05)	Stall	Stall	Stall
Tanzania (2010)	Decline	Decline	Stall
Uganda (1988/89)	-	-	-
Uganda (1995)	Decline	Decline	Decline
Uganda (2000/01)	Stall	Stall	Decline
Uganda (2006)	Decline	Decline	Stall
Uganda (2011)	Decline	Decline	Decline
Zambia (1992)	-	-	-
Zambia (1996)	Decline	Decline	Decline

Zambia (2001/02)	Decline	Stall	Decline
Zambia (2007)	Stall	Stall	Stall
Zimbabwe (1988)	-	-	-
Zimbabwe (1994)	Decline	Decline	Decline
Zimbabwe (1999)	Decline	Decline	Decline
Zimbabwe (2005/06)	Decline	Stall	Decline
Zimbabwe (2010/11)	Stall	Stall	Stall
Botswana (1988)	-	-	-
Lesotho (2004)	-	-	-
Lesotho (2009)	Decline	Decline	Stall
Namibia (1992)	-	-	-
Nambia (2000)	Decline	Decline	Decline
Nambia (2006/07)	Decline	Decline	Decline
South Africa (1998)	-	-	-
Swaziland (2006/07)	-	-	-

Table 4. Frequency of Stalling in Pairs

	National	Rural	Urban
Benin	0.33	0.00	0.33
Burkina Faso	0.33	0.33	0.33
Cote D'Ivoire	0.00	0.50	0.00
Ghana	0.25	0.25	0.50
Guinea	0.50	0.50	0.50
Liberia	0.00	0.00	0.00
Mali	0.33	0.33	0.33
Niger	0.00	0.00	0.33
Nigeria	1.00	0.00	0.00
Senegal	0.00	0.25	0.00
Cameroon	0.67	0.67	0.67
Chad	0.00	1.00	0.00
CDR	1.00	1.00	1.00
Gabon	0.00	1.00	1.00
Burundi	0.00	0.00	0.00
Comoros	0.00	0.00	0.00
Eritrea	0.00	0.00	0.00
Ethiopia	0.00	0.50	0.50
Kenya	0.25	0.25	0.25
Madagascar	0.00	0.50	0.50
Malawi	0.00	0.00	0.00
Mozambique	1.00	1.00	0.50
Rwanda	0.25	0.25	0.25
Tanzania	0.25	0.50	0.50
Uganda	0.25	0.25	0.25
Zambia	0.33	0.67	0.33
Zimbabwe	0.25	0.50	0.25
Botswana	0.00	0.00	0.00
Lesotho	0.00	0.00	0.50
Namibia	0.00	0.00	0.00
Average:	0.23	0.34	0.29

Table 5. Rate of Stalling in Total, Urban, and Rural Fertility

Trends in Total Fertility Rates	Number of Pairs	Percentage
Experienced stalling	17	25%
Did not experience stalling	50	75%
Total	67	100%

Trends in Urban Fertility Rates	Number of Pairs	Percentage
Experienced stalling	24	36%
Did not experience	43	64%
Total	67	100%

Trends in Rural Fertility Rates	Number of Pairs	Percentage
Experienced stalling at least once	22	31%
Did not experience stalling	48	69%
Total	70	100%

Table 6. Temporal Frequency of Stalling

	National	Rural	Urban	Total
1980s-1990s	0	3	1	4
1990s-2000s	9	12	8	29
2000s-2010s	8	9	13	30
Total	17	24	22	63

Table 7. Levels and Changes in Fertility by Initial Level of Fertility and Place of Residence

Initial National TFR	Levels						Changes					
	National		Rural		Urban		National		Rural		Urban	
	TFR_0	TFR_1	TFR_0	TFR_1	TFR_0	TFR_1	Absolute	Relative	Absolute	Relative	Absolute	Relative
>6.5	6.91	6.56	7.24	7.04	5.39	4.81	0.35	5%	0.2	3%	0.58	11%
5.5-6.5	5.98	5.65	6.55	6.28	4.56	4.16	0.33	6%	0.27	4%	0.4	9%
<5.5	4.77	4.52	5.56	5.36	3.58	3.36	0.25	5%	0.2	4%	0.22	6%

Table 8. Levels and Changes in Fertility by Initial Level of Fertility and Place of Residence

Initial National TFR	Levels						Changes					
	National		Rural		Urban		National		Rural		Urban	
	TFR_0	TFR_1	TFR_0	TFR_1	TFR_0	TFR_1	Absolute	Relative	Absolute	Relative	Absolute	Relative
>6	6.6	6.2	7	6.8	5.1	4.6	0.4	6%	0.2	3%	0.5	10%
5-6	5.6	5.3	6.3	6	4.2	3.8	0.3	5%	0.3	5%	0.4	10%
4-5	4.5	4.3	5.3	5.2	3.3	3.3	0.2	4%	0.1	2%	0	0%
<4	3.8	3.7	4.4	4.5	2.5	2.6	0.1	3%	-0.1	-2%	-0.1	-4%

Table 9. GDP Per Capita for Countries with Pairs of Surveys

Country	GDP Per Capita
Western	
Benin	804.7
Burkina Faso	683.9
Cote d'Ivoire	1528.9
Ghana	1858.2
Guinea	523.1
Liberia	454.3
Niger	415.4
Senegal	1046.6
Mali	715.1
Nigeria	3005.5
Sierra Leone	679
Togo	636.4
Average	**1029.258333**
Middle	
Cameroon	1328.6
Chad	1053.7
Congo (Brazzaville)	3167
Congo Democratic Republic	484.2
Gabon	11571.1
Average	**3520.92**
Eastern	
Burundi	267.1
Comoros	815
Eritrea	543.8
Ethiopia	505
Kenya	1245.5
Madagascar	463
Malawi	226.5
Mozambique	605
Rwanda	638.7
Tanzania	694.8
Uganda	572
Zambia	1844.8
Zimbabwe	953.4
Average	**721.1230769**
Southern	
Lesotho	1125.6
Namibia	5693.1
Average	**3409.35**

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The University of Franche-Comté May 2012 – August 2012

WORK EXPERIENCE

Morgan Stanley New York, NY
Summer Analyst June 2014 – August 2014

- Ensured timely and accurate processing of credit default swaps by reconciling trades and maintaining morning and end of day reports
- Led Summer Analyst team project to create checklists for the Alternative Investments group to standardize procedures and mitigate risk

Cognitive and Social Development Laboratory University Park, PA
Research Assistant August 2013 – May 2014

- Collected, coded, and analyzed data for research projects exploring influences of formal and informal education in development

Teach For America Philadelphia, PA
Operations Coordinator June 2013 – August 2013

- Provided technical support and training for over 100 staff and corps members
- Managed Teach For America social media accounts

ITS Laboratory Consulting University Park, PA
Computer Laboratory Consultant February 2012 – May 2013

- Developed expertise in the software and equipment in the computer laboratories
- Provided assistance to computer users by helping to troubleshoot technical issues

Ask Big Questions Foundation University Park, PA
Ask Big Questions Fellow July 2012 – May 2013

- Utilized peer-to-peer engagement strategies to promote civil discourse on campus

LEADERSHIP EXPERIENCE

Omega Phi Alpha National Service Sorority University Park, PA
VP of Recruitment and Membership Development September 2012 – December 2014

- Created and implement recruitment plan and mentor new members
- Completed over 50 hours of community service each semester

Penn State Dance MaraTHON Finance Committee University Park, PA
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- Processed over $10,000 collected on behalf of THON, a dance marathon that raises funds and promotes awareness of pediatric cancer