Anticipating the Future of African Fertility Transitions: An Examination of Youth Fertility Preferences in Sub-Saharan Africa

Introduction

Context: Fertility rates in sub-Saharan Africa have remained persistently high, at 5.1 births per woman in 2005-2010 (Bongaarts and Casterline 2013). There have been gradual fertility declines since the 1980s. Some countries experienced fertility stalls in the early 2000s, though these were largely overstated (Machiyama 2010). Regardless, fertility in sub-Saharan Africa is higher than any other region, and fertility declines in sub-Saharan Africa are much slower than were declines in Latin America, Asia, and the Middle East (Cleland 2011). This has significant policy implications. Current population trends threaten to overwhelm the region's resources. In the Sahel, for example, increasing population density is predicted to exhaust ecological resources, undermining food security (Seaquist et. al. 2014). On the other hand, reductions in fertility produce a "demographic dividend" because delayed childbearing results in a larger portion of the population being available for productive activities. Assuming that policies exist to take advantage of this larger labor pool, the demographic dividend can facilitate economic and social development (Bloom et. al. 2003). Understanding Africa's progress in reducing fertility rates is important for planning of policy initiatives and forecasting of future demands on resources and infrastructure. Specifically, examining fertility preferences is important because preference changes are a necessary precondition to family planning. There is a strong inverse correlation between Desired Family Size (DFS) and demand for contraception ($R^2 = 0.79$), which is in turn is tightly correlated with TFR (R^2=0.82) (Bongaarts 2010). While contraceptive availability can be easily affected by government policy, fertility preferences are more difficult to change and less well understood.

Additionally, it is important to understand trends in fertility inequality. Higher Socio-Economic Status (SES) is typically correlated with lower fertility. While this disparity is not necessarily problematic in small amounts, large fertility differentials between SES groups exacerbate wealth inequality because higher fertility in low SES groups strains limited household resources. High fertility reduces the amount of resources that can be invested in each child, while early childbearing makes it more difficult for youth to increase their status. Fertility-SES differentials are also important to understand because fertility reductions that are concentrated at high SES groups might be less promising than reductions which are broad-based. There is currently a dearth of literature examining fertility differentials within developing countries; studies examining sub-Saharan Africa tend to focus on differences between countries rather than differences within countries.

Research Questions: This paper addresses how fertility transitions differentially affect socio-economic strata. Current literature does not adequately address fertility and preference inequality across the fertility transition. Classical transition theory, as "restated" by Caldwell, often assumes that countries undergo fertility transitions as one unit (Caldwell 1976). By contrast, diffusion theory and Shapiro's three-stage model indicates that fertility transitions might first act through higher-SES groups before extending to all wealth groups. It is largely unclear, though, how transitions differentially affect wealth groups specifically in the African context. In this paper, we address this issue by analyzing data from eighty-one African DHS surveys. We seek to answer three questions. First, we investigate how fertility inequality between SES groups changes throughout the fertility transition. Second, we investigate how fertility *preference* inequality changes throughout the fertility transition. Finally, we investigate how the effect of SES on fertility preferences changes throughout the fertility transition. We use a linear decomposition method to assess whether preference changes are due more to SES distributions, to within-SES group changes, or to the effect of SES. Structural explanations for fertility change, developed by Caldwell and others, predict that fertility inequality largely remains constant through the fertility transition, and that any changes in fertility inequality are due to changes in SES structure. By contrast, diffusion theory and Shapiro's three-stage model predicts that fertility inequality should rise in the beginning of the transition before falling as all groups get access to family planning resources, and that inequality changes are largely be due to within-group changes.

Throughout our analysis, we focus on women between the ages of fifteen and twenty-four. The reasons for this are six-fold. First, youth fertility patterns have a large effect on total fertility rates. In sub-Saharan Africa, fertility typically begins early and is characterized by high inter-birth intervals (Bongaarts and Caserline 2013, Caldwell 1992). As a result, delayed childbearing should have a large impact on TFR. Second, youth fertility has occurred recently, so it is a more quickly changing indicator. Third, youth fertility patterns have important implications for gender equality. Putting off childbearing makes it easier for women to attain higher education, start careers, and enter parenthood on equal footing with their partners. Fourth, youth preference indicators are less prone to rationalization bias, because youth have typically had few children. Fifth, youth fertility preferences may be predictive of future fertility trends, because youth preferences may carry-over into adulthood. Sixth, sub-Saharan Africa has a bottom-heavy population distribution, with youth making up roughly twenty percent of total population (Prata 2013). As these youth enter their peak childbearing years, their fertility patterns will largely determine overall population trends (Prata 2013).

Previous Literature

The Fertility Transition: Much scholarship has addressed factors driving the fertility transition. Conventional demographic theory approaches fertility changes as a two-part process: first, fertility preferences change due to social forces, second, these preference changes are translated into reduced fertility through family planning methods. As a result, understanding fertility changes requires both understanding why desired childbearing changes and how couples limit their fertility in response. In addressing preference changes, Caldwell put emphasis on changes in the role of children (Caldwell 1982), as well as westernization, secularization, and education (Kirk 1996). At the same time, economists such as Richard Esterlin modeled fertility as an economically calculated decision, based on supply and demand for children, among other factors (Esterlin 1985). Current understandings of preference changes focus on urbanization, education, macroeconomics, and mortality rates (Bogarts and Casterline 2014). On the family planning front, surveys such as the DHS have allowed for better understanding of barriers to contraceptive use. Such studies showed that unmet need in developing countries tends to be caused by perceived lack of exposure to pregnancy, opposition to family planning, method-related problems, and lack of knowledge about contraceptive methods (Westoff 2001), among other barriers.

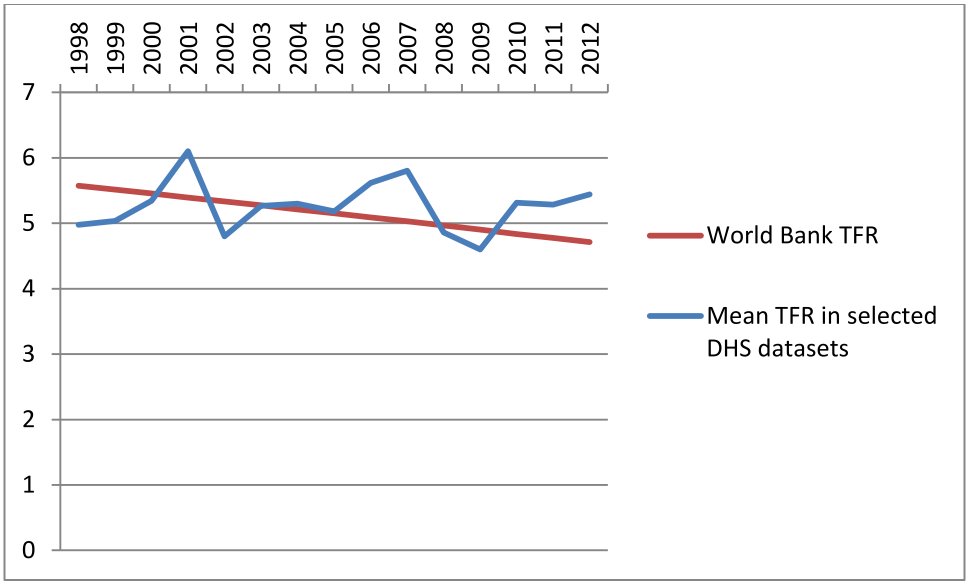
Patterns of Fertility Change: Of particular interest are patterns of fertility change within countries. Early work on fertility transitions was often focused on fertility change on the country-level, assuming that societies went through the fertility transition as a unit. Early work also equated demographic transition with a normalized process of social and economic modernization. By contrast, more recent "diffusion theories" have emphasized ideational change and diffusion of ideas. Diffusion theory is characterized by a notion that attitudes and behaviors are first adopted by a vanguard population, before spreading to other populations through selective social learning. Westernization, mass media, and face-to-face social networks have been proposed as drivers of this process (Casterline 2001). Central to diffusion theory is a notion that attitudes and behaviors can act independently of economic and structural changes. Bongaarts and Watkins (1996), for example, propose that the development-fertility relationship may be purely coincidental. Palloni (2001) draws a dichotomy between structural explanations, which depend on changes in social position or wealth, and diffusion explanations, which involve a cascading mechanism that is independent of wealth. Most modern demographers, however, view both structural and ideational changes as important contributors to fertility change.

Fertility Inequality Trends in the Developing World: Reproductive inequality has been recognized as worth studying, both because it shapes the consequences of fertility decline and because it exacerbates economic inequality. For example, De La Croix and Doepke (2003) used a theoretical model to show that differential fertility and the quality/quantity childrearing tradeoff can cause massive amounts of wealth inequality to be created and perpetuated. This theoretical finding was supported by Kremer and Chen (2002), who found a country-level correlation between fertility differentials and wealth inequality (Gini).

Existing literature has not thoroughly explored wealth- fertility differentials across sub-Saharan fertility transitions. Skirbekk (2008) examined fertility-SES differentials, but used data points ranging back to the 1800's and did not specifically examine sub-Saharan Africa. Bongaarts (2003) found considerable fertility differentials between educational groups across the transition, though it is unclear to what extent this was because of the effect of education versus education functioning as a proxy for wealth. These findings were not conclusive regarding how differentials changed during the transition, but seemed to suggest a constant effect of education throughout the transition, rather than a leader-follower effect. Barakat (2014) explored fertility concentration using a variety of indicators, and found evidence of an inverse-U in fertility concentration, with fertility concentration initially rising before falling at lager stages. However, Barakat did not examine inequality between SES groups, but rather total concentration between individuals. Shapiro and Tambashe (2000) examined urban-rural fertility differentials, finding a leader-follower pattern in which fertility first falls in urban centers and then later falls in rural areas. Shapiro used these findings to propose a three-stage model in which fertility first diverges between groups and later converges. However, it is unclear if this is due to urban / rural differences, or the higher concentration of wealthy individuals in urban centers. Giroux et. al. (2008) use DHS data from 30 sub-Saharan countries to show that both wealth-fertility differentials and inequality increase as countries progress through demographic transition. Additionally, Giroux et. al. show that fertility differentials can yield drastically different results from true inequality measures. This is because differentials are calculated by subtracting top SES group TFR from bottom SES, neglecting both middle-group behavior and group size.

Data and Methods

Survey Data: We utilize eighty-one DHS surveys from twenty-five sub-Saharan counties. We used all available standard DHS surveys from sub-Saharan Africa for which comparative wealth index (CWI) coefficients were available. To determine which countries are in sub-Saharan Africa, we utilized the United Nations geo-scheme classification, which includes all African countries except for Sudan, Western Sahara[i], and countries bordering the Mediterranean Sea. We further restricted our sample to countries for which two or more standard DHS surveys were available. This was necessary in order to compare data between time-points. Although our sample does not represent sub-Saharan Africa as a whole, it covers the majority of countries and sixty-nine percent of the population. We use individual recode files restricted to women aged fifteen to twenty-four. This age range is consistent with the definition of youth adopted by the United Nations for statistical purposes (UN Definition of Youth). We also weighted cases using standard DHS sample weights, which adjust for over- and under-sampling within the survey area.



Calculation of Wealth: Wealth is notoriously hard to compare between countries, especially in the developing world. DHS surveys do not collect information on household income. Even if they did, this information would be difficult to use for multi-country analysis because cost of living and household structures vary greatly between geographic locations. However, the DHS does collect a variety of standard-of-living indicators, which the DHS uses to calculate a household wealth index. Unfortunately, this wealth-index is country- and time- specific, and thus cannot be compared between countries or between time points.

In order to construct SES groupings that can be compared between surveys, we use the DHS survey-specific wealth indexes to calculate a Comparative Wealth Index (CWI)**.** This approach was developed by Rutstein and Staveteig (2014) as a method for comparing SES between DHS datasets. They used eight binary standard of living indicators to compare survey-specific wealth indexes with a baseline wealth index. Specifically, they used four "basic needs" (inadequate dwelling construction, overcrowded housing, inadequate sanitation, and economic dependency), as well as television, refrigerator, automobile, and telephone ownership. For each survey, indicators were used to create "cut-points": wealth levels at which half of the population had a specific indicator. These cut-points were then linearly regressed between the baseline survey (Vietnam 2002) and other recent DHS surveys. The result was alpha and beta values for each survey, which can be used to linearly transform survey-specific wealth indices into a Comparative Wealth Index. These eight indicators seemed to capture wealth fairly well, as evidenced by Rutstein and Staveteig's finding that the CWI was robust both to changes in the baseline survey and to potential removal of an indicator cutpoint. Use of the CWI is preferable to calculation of a new wealth measure because different surveys have different indicators available; by transforming an existing wealth index we avoid error caused by missing data.

Rustein and Staveteig Experimental Comparative Wealth Index

Measurement of Fertility Preferences The DHS collects several indicators of fertility preference, including DFS, wanted status of recent births, and desire for more children. These measures all have some drawbacks; for example DFS and wanted status are subject to rationalization and rosy retrospection, while desire for more children is subject to variation in birth intervals (Bongaarts 2011). Here we focus on DFS because it has been most tightly linked to fertility behavior. While our datasets all included DFS, respondents were able to give a non-numerical answer, for example "I do not know" or "it is up to the will of God". Our calculations of DFS assume that the respondents who gave non-numerical answers have the same average DFS as the respondents in their wealth group who gave numerical answers. Non-numerical responses typically made up less than twenty percent of cases.

Calculation of Inequality in Fertility and Desired Family Size We first calculate the inequality between wealth groups in number of children and in Desired Family Size. SES groupings were created by separating each country's earliest dataset into five equal quintiles, and then using these cut-points for later datasets. This approach created SES groups that were equivalent across time-points, and thus captured changes in wealth distributions.

We measured inequality using the Theil index. The Thiel index is a measure of negative entropy, with a higher Theil index (T_T) indicating more disorder (inequality), and a Theil of zero indicating total entropy (equality). T_T is normalized by dividing by the natural log of the number of wealth groups so that it ranges from 0 to 1, which is total disorder. However, a normalized Thiel of 1 would indicate that all children are had by one wealth group; fertility inequality above 0.05 is in fact quite large. The Thiel is not as commonly used as the Gini coefficient; however the Thiel is advantageous because it can be decomposed. We do not de-compose fertility inequality here, but wanted to keep the option available for further analysis. In addition to calculations of inequality, we also present overall trends in youth fertility and fertility preferences.

Decomposition of Youth Desired Family Size Calculating preference inequality merely describes differences between groups. In order to better understand the changing relationship between wealth and youth DFS, we employ a mixture of linear regression and advanced decomposition techniques. Our analysis begins with a basic decomposition to determine how much of the change in DFS is due to changes within socioeconomic groups compared to changes in the relative size of socioeconomic groups. We assume that national youth DFS at time *t* is equal to average group specific fertility preference ($d_{j,t}$) weighted by the size of each SES group ($w_{j,t}$):

$$D_t = \sum d_{jt} * w_{jt}$$

This expression is then decomposed in order to determine whether changes in youth DFS are driven predominantly by changes in DFS within SES groups (Term 1) or by changes in the size of each SES group (Term 2):

$$\Delta D = \bar{d} * \Delta w_j + \bar{w} * \Delta d_j$$

Term 1: Compositional Change	Term 2: Behavioral Change

Identifying where the change happens provides insight into how much of the decline in DFS is driven simply by expansion of the proportion of the population with higher levels of wealth versus by changes in preference patterns of each SES group.

While the basic decomposition indicates how much the change was driven by changing SES, it does a poor job at describing how change within socioeconomic groups affects average DFS. We further decompose within-group changes into three separate components to better understand within-group preference changes. Within-group preferences are regressed on SES at both time points using a linear model. Within group changes (Term 2) are broken into baseline changes (Term 2a), changes in the effect of wealth (Term 2b), and residual changes (Term 2c):

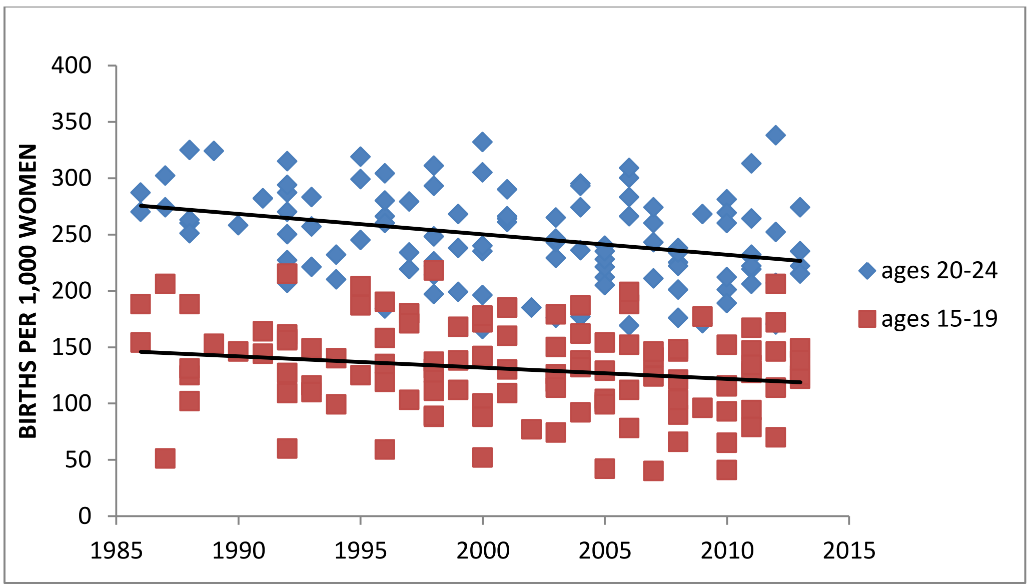
$$\Delta D = \sum \bar{d}_i \Delta w_i + \sum \bar{w}_i \Delta\alpha + \sum \bar{w}_i \Delta\beta * SES_i + \sum \bar{w}_i \Delta\mu$$

Term 1: Compositional change (Macroeconomic Forces)	Term 2a: Baseline change (cultural forces)	Term 2b: Changes in the Effect of Wealth (How much wealth matters)	Term 2c: Residual change

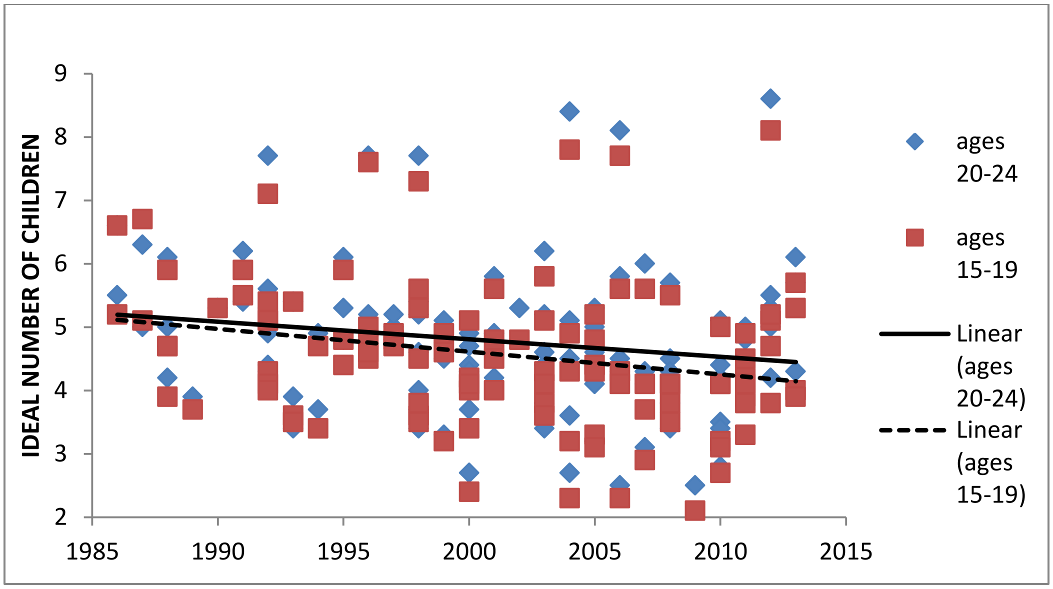
The practical question answered by this decomposition is whether changes in youth fertility are driven primarily by the direct effects of increased prosperity, by broad changes in youth preferences, by changes concentrated among the more affluent, or by changes not described by our model. In other words, we can empirically determine the relative effects of macroeconomic changes (Term 1), cultural changes (Term 2a), and changes in the power of wealth (Term 2b). While looking only at descriptive statistics would indicate the relative changes in youth DFS across SES gradients, our decomposition is crucial for understanding the relative contributions of culture and macro-economic forces.

Results

Trends in Youth Fertility: We begin by examining trends in youth fertility and DFS. Like total fertility rates, youth fertility rates have declined gradually since the DHS surveys began. Linear regression showed an average fertility reduction of 1.0 birth per thousand women per year for the 14-19 age group and 1.8 births per thousand women per year for the 20-24 group. We also observed gradual declines in youth ideal number of children, with the younger group declining in fertility preferences slightly faster. This data suggests gradual reductions in both youth fertility and preferences, despite massive variation throughout the transition. However, because the DHS varies which countries are surveyed and the frequency with which these surveys are conducted, these results may be affected by sampling bias.



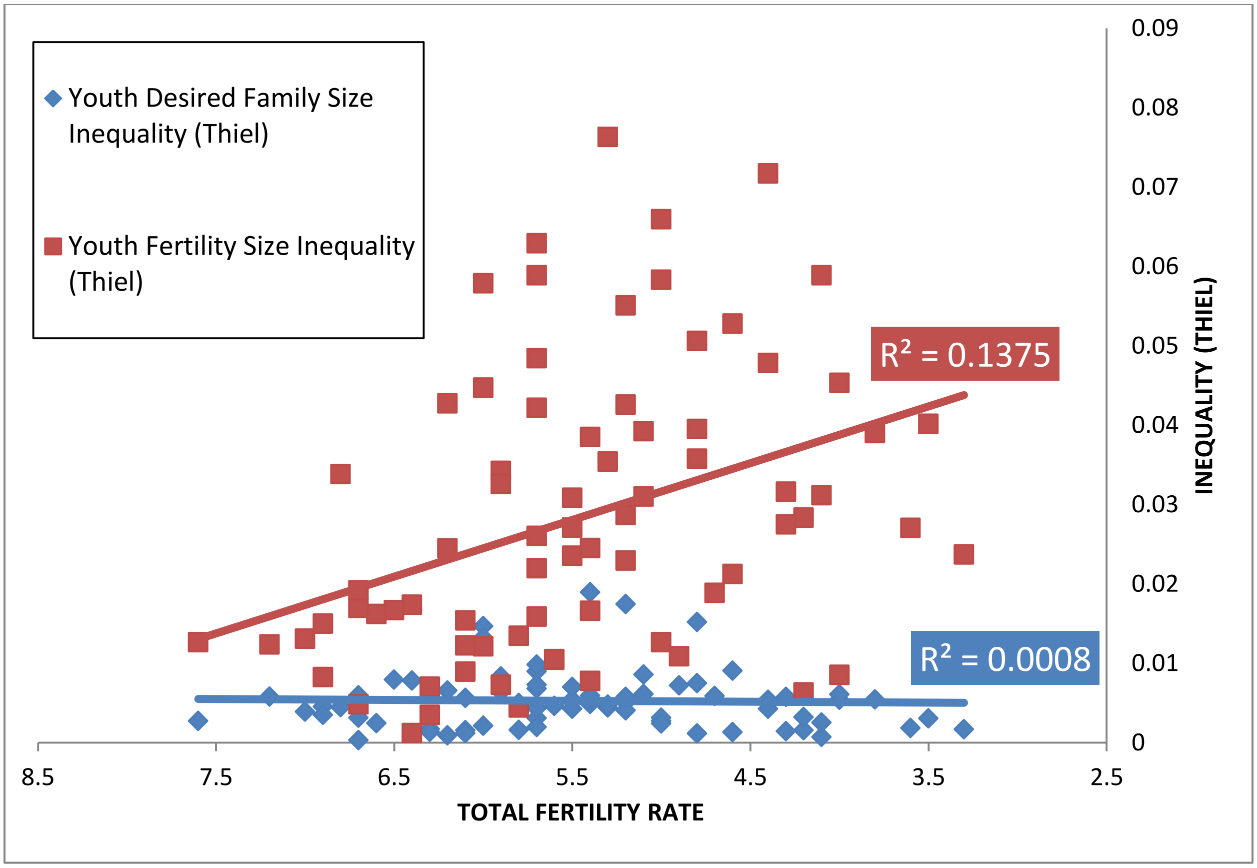
Gradual Reductions in Youth Fertility



Gradual Reductions in Youths' Ideal Number of Children

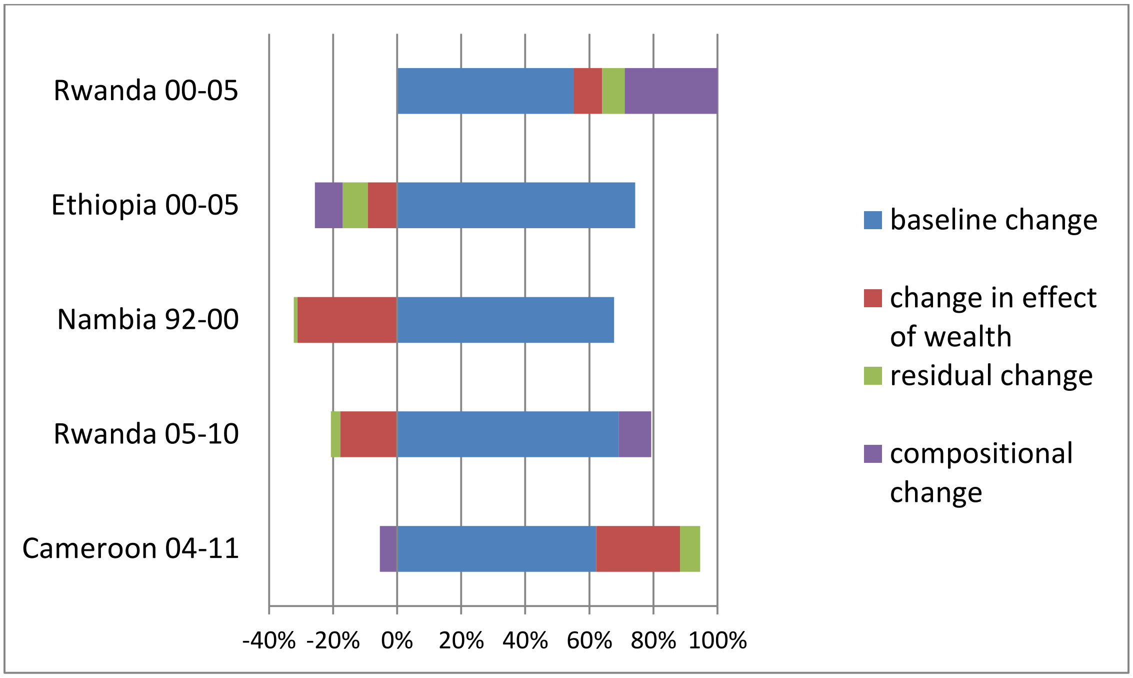
Trends in Youth Fertility Inequality: It is clear that youth fertility preferences are declining, but descriptive statistics do not indicate whether this is driven by broad changes affecting all strata of society, or by changes within high SES groups. This is important to address both because high fertility inequality would be predicted to increase income inequality, and because changes affecting only a small portion of society might be less promising than broad based changes. Additionally, examining changes in fertility inequality tests for a "three-stage" pattern of transition, in which fertility changes begin in high-SES groups and then diffuse to lower SES groups.

We found drastic increases in youth fertility inequality as countries progress through fertility transitions, with youth fertility inequality about twice as high in countries with lower fertility. This supports a "three-stage" model of fertility transition. However, very few countries in the sample had a TFR under 3.5, so it is unclear if fertility inequality will decline at later points in the fertility transition. Inequality in youth DFS remained constant throughout fertility transitions. This suggests that fertility preferences do not begin at high wealth groups and diffuse down, but rather affect all SES groups equally. The contrast between increasing fertility inequality and stagnant preference inequality is surprising, and suggests that changing fertility inequality is not attributed to preferences.

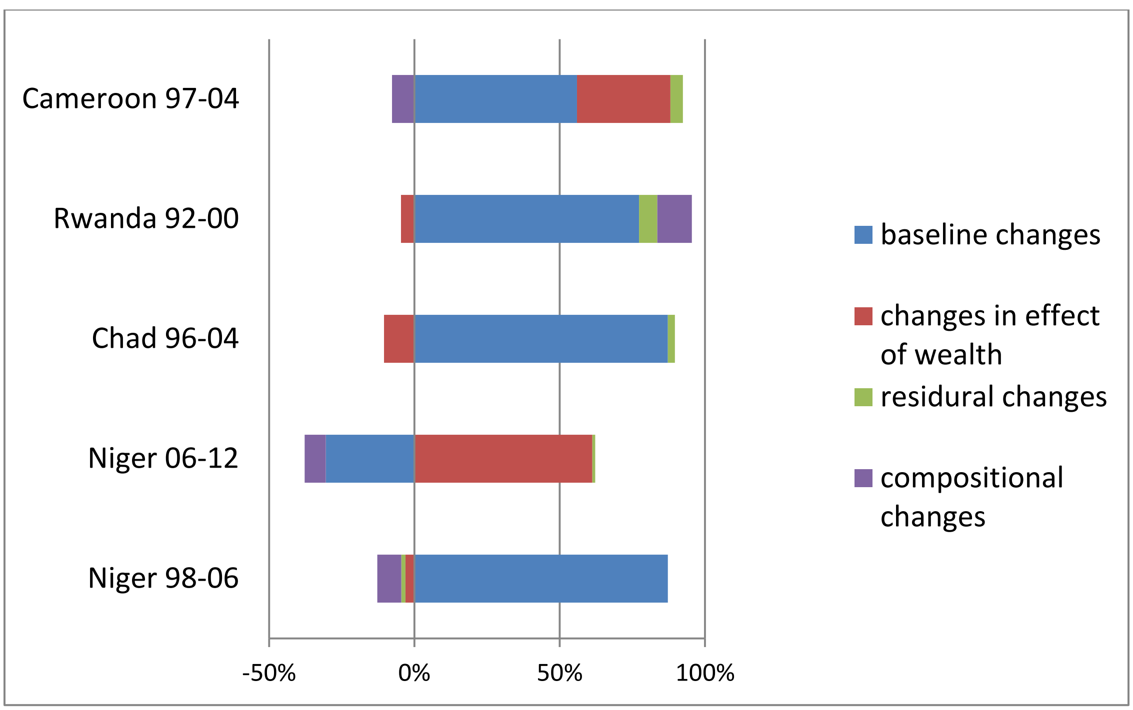


Increases in fertility inequality without corresponding changes in preference inequality

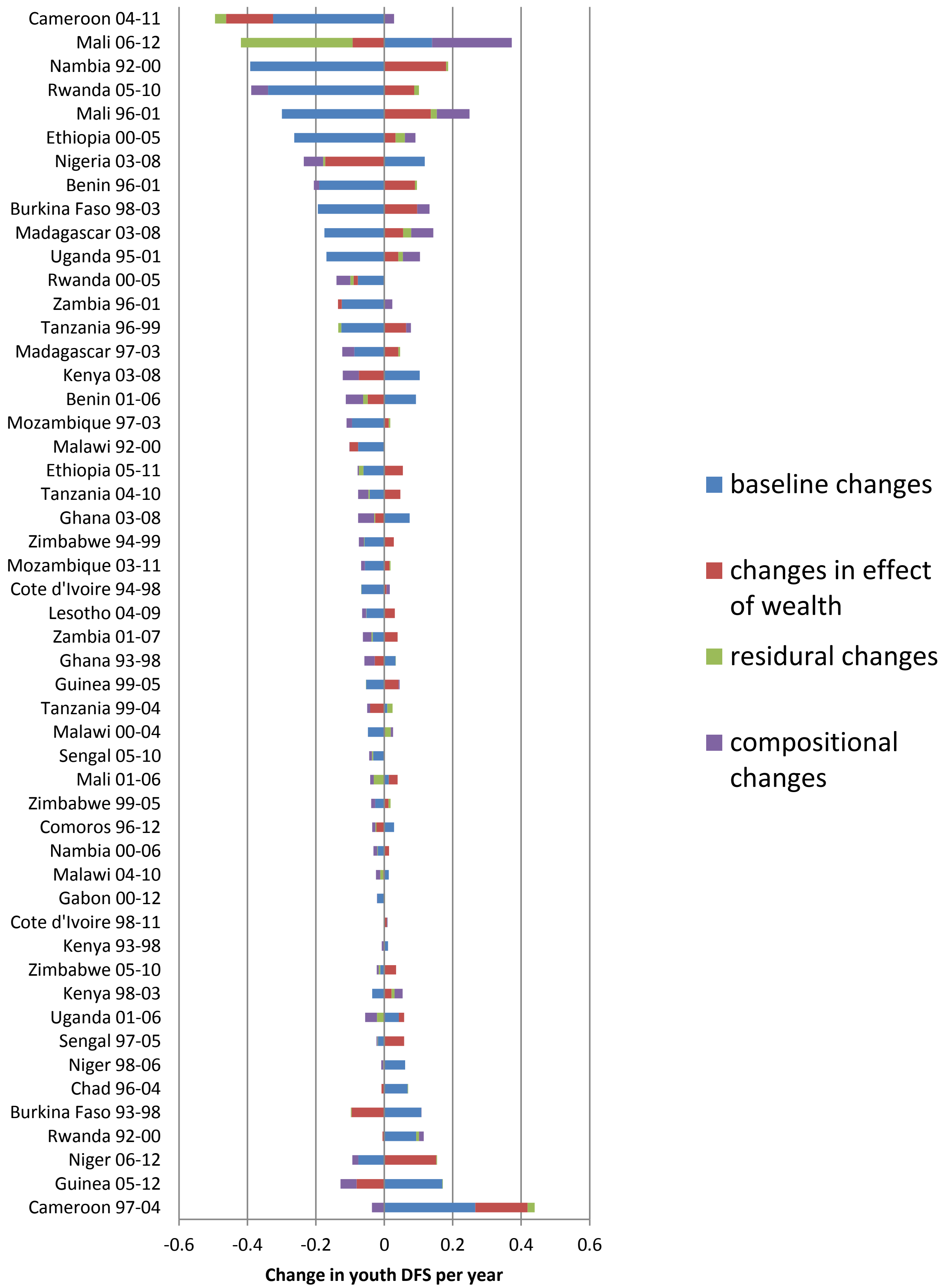
Decomposition of Fertility Inequality: In order to better understand the relationship between wealth and Desired Family Size, we performed a decomposition of DFS using the method previously described. The aim of this was to identify the contributions of macro-economic forces (Term 1) and cultural forces (Term 2a). We found that the majority of preference changes were due to broad-based, presumably cultural changes that affected all groups evenly. These baseline changes reduced desired family size on average by 0.04 children per year, and were especially powerful at early phases in the fertility transition. While these broad-based changes were typically negative, they also increased DFS in certain cases. There were also small contributions due to changes in the effect of wealth, though on balance these had a contribution of only +0.01 children per year. Changes in SES distribution (macroeconomic changes) made up only fourteen percent of preference changes. This is notable: while SES changes may be significant in shaping fertility rates, this is not the case with DFS. We observed very small residual changes, on average less than seven percent of DFS changes, indicating that our linear model described SES-DFS differentials well.



Countries with Highest Reductions in DFS



Countries with Highest Increases is Youth DFS



Cameroon 04-11
Mali 06-12
Nambia 92-00
Rwanda 05-10
Mali 96-01
Ethiopia 00-05
Nigeria 03-08
Benin 96-01
Burkina Faso 98-03
Madagascar 03-08
Uganda 95-01
Rwanda 00-05
Zambia 96-01
Tanzania 96-99
Madagascar 97-03
Kenya 03-08
Benin 01-06
Mozambique 97-03
Malawi 92-00
Ethiopia 05-11
Tanzania 04-10
Ghana 03-08
Zimbabwe 94-99
Mozambique 03-11
Cote d'Ivoire 94-98
Lesotho 04-09
Zambia 01-07
Ghana 93-98
Guinea 99-05
Tanzania 99-04
Malawi 00-04
Sengal 05-10
Mali 01-06
Zimbabwe 99-05
Comoros 96-12
Nambia 00-06
Malawi 04-10
Gabon 00-12
Cote d'Ivoire 98-11
Kenya 93-98
Zimbabwe 05-10
Kenya 98-03
Uganda 01-06
Sengal 97-05
Niger 98-06
Chad 96-04
Burkina Faso 93-98
Rwanda 92-00
Niger 06-12
Guinea 05-12
Cameroon 97-04
-0.6
-0.4
-0.2
0
0.2
0.4
0.6
Change in youth DFS per year
baseline changes
changes in effect of wealth
residural changes
compositional changes

Conclusions

In this paper, we sought to answer three questions: 1) What are the trends in youth fertility and fertility preferences in sub-Saharan Africa? 2) Are these trends broad-based or driven by increasing SES-fertility differentials? 3) What is driving changes in youth Desired Family Size? We first showed that there are gradual reductions in youth fertility and fertility preferences, despite wide variation, along the fertility transition. We then found that fertility inequality increases drastically during early sub-Saharan transitions, though it is unclear if it will be reduced at later stages. Notably, DFS inequality remains constant throughout the transition. This suggests that the ideational changes necessary for fertility reductions act on all classes equally. This was confirmed by our advanced decomposition approach, which found that baseline changes make up fifty-three percent of youth preference changes, and that there is no consistent trend in the effect of wealth on youth DFS. Apparently, the forces that increase SES-fertility differentials do not act through fertility preferences. It is still unclear what is driving fertility differentials, but we suspect that unequal access to contraceptives and family planning knowledge plays a role.

Our dataset was restricted to women under the age of twenty four, in part because DFS at older ages is subject to confirmation bias. It is unclear to what extent these conclusions apply to older populations. However, because youth fertility plays such a predominant role in shaping population trends, this focus is justified.

Our findings have both theoretical and practical applications. Shapiro's three-stages model suggests that family-planning starts in wealth, urban, westernized cores before diffusing throughout countries. Our results suggest that while the *ability* to limit fertility is first present in higher SES groups, the *desire* to limit fertility that this ability fulfills is present in all social classes. In other words, the three-stage model describes fertility outcomes, but not fertility desires. Furthermore, our advanced decomposition indicates that preference changes neither require macro-economic changes nor are usually driven by them. Practically, this suggests that efforts to target high fertility in impoverished communities should focus on providing contraceptives and knowledge, rather than changing ideation. This is a positive finding: it is much easier to address access to family planning than it is to change fertility preferences. Rising fertility inequality, however, is a pressing problem which should be addressed in order to limit impacts on wealth inequality. As previously mentioned, fertility differentials threaten to exacerbate wealth inequality and thus to compromise standards of living. The observation that youth fertility is diverging between high- and low-SES groups is thus concerning. As Sub-Saharan Africa slowly reduces its fertility, disparities between wealthy youth and poor youth are growing. Wealthy youth are able to delay fertility and reap the benefits of development, while poorer youth have children earlier while being less able to provide for them. Further research is necessary to identify what is driving increases in fertility inequality.

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