The Dynamics of Timing and Spacing of Births in Ethiopia: A focus on urban-rural differences

Union for African Population Studies, Fifth African Population Studies
Arusha, Tanzania 10-14 December 2007

Draft September 29, 2007

Daniel Sahleyesus
SSHRC Post-Doctoral Fellow, Centre for International Health &
Research Associate, Comparative Program on Health and Society
University of Toronto
155 College St., Suite 569, Health Sciences Building
Toronto, ON, M5T 3M7
E-mail: dan.sahleyesus@utoronto.ca

Roderic P. Beaujot
Professor of Sociology
Director, Population Studies Centre
Dept. of Sociology,
Room 5306 Social Science Centre,
University of Western Ontario,
London, ON, N6A 5C2
E-mail: rbeaujot@uwo.ca

Introduction

The 2000 and the 2005 Ethiopia Demographic and Heath Surveys reported that the Total Fertility Rate for the country stood at 5.9 and 5.4 children per woman respectively. However, the level of fertility observed in these surveys varies markedly between urban and rural areas; urban areas have a remarkably low fertility compared to rural areas. Although fertility differences between urban and rural areas have invariably been observed across populations of the world, there are three issues that motivated this study of Ethiopia. First, there is a difference of over three children per woman between urban and rural areas, which is a substantial difference compared to that of other countries. Second, some urban areas have even achieved a below replacement level fertility. Third, although urban areas are better served with economic progress and social services, the overall social and economic development of these centers does not parallel the level that is normally seen in the literature as necessary to achieve this kind of fertility decline. The main research question of this study, therefore, is whether there are fundamental socio-demographic and socio-cultural factors that affect the timing and spacing of births for urban and rural areas in Ethiopia.

Theoretical considerations

From the perspective of classical demographic transition theory, a rise in life expectancy, wider use of contraceptives, industrialization and urbanization are deemed to radically change the behavior of couples with respect to family size (Notestein, 1945). Fertility would change in response to the gradual change in the cultural, social and institutional arrangements that had promoted higher reproductive behavior (Notestein, 1945). In his "social capillarity" explanation, Dumont argued that the aspirations of individuals to move up in the socioeconomic ladder would motivate people to control their fertility (Spengler, 1979). McDonald (2000) observes that in high fertility societies women may choose to have fewer births in order to shape their own and their children's future for the better. However, at the early stage of the transition, smaller family size may not advantage the economic wellbeing of the family. Bongaarts (2002), emphasizing the crucial importance of progress in human development for the future course of fertility has noted that on the average a life expectancy of 75 years combined with literacy near 95 percent is needed for a country to approach replacement level fertility.

The role of improved child survival in affecting fertility has also been extensively discussed by the earliest as well as contemporary studies of demographic transition (Notestein 1945; Davis 1963; Cleland 2001). For instance, Cleland (2001) argues that in the case of developing countries, a plausible explanation for fertility change comes from the preceding large mortality reduction. However, he singled out the "mediating role of the innovation that provides the main behavioral mechanism for fertility reduction, namely the routine deployment of contraception within marriage" (Cleland, 2001, 85). Another suggestion is to examine the causes and consequences of reproductive change by employing a unified framework that brings together socioeconomic changes and changes in ideologies, attitudes, and the mechanisms of fertility decline (Caldwell 2001).

These theoretical approaches suggest that people's fertility desires are the reflections of the cultural and social features of society, while the economic structure provides the constraints within which they operate. In societies or groups where large

family values dominate, it is highly likely that people would have higher desired as well as achieved fertility (Shah & Nathanson, 2004).

Data and methods

This study used data obtained from the 2000 Ethiopia Demographic and Health Survey (ETDHS) which was conducted by the Central Statistical Authority (CSA) under the auspices of the Ministry of Health with financial and technical support from the United States Agency for International Development (USAID), the United Nations Population Fund (UNFPA), and ORC Macro under the MEASURE DHS+ program. The ETDHS collected information from a nationally representative sample of 15,367 women aged 15-49 and 2,607 men aged 15-59.

Reliable estimates of the timing and durations between successive births depend on the accuracy and completeness of information reported by respondents. The sampling errors for the Ethiopia DHS are calculated for variables of primary interest and given in the final survey report (CSA & ORC Macro, 2001). Apart from minor variations observed for the estimates of sub-populations, the relative standard error for most estimates at the national level are small, implying that the DHS sample allows for reliable estimates. The survey achieved response rates of 98 and 94 percent for eligible women and men respectively. Latest rounds of DHS are also known to benefit from the experiences of previous rounds which add to their improved qualities. Previous researchers who used the same dataset (Sibanda et.al, 2003) have suggested that these data are of good quality. Overall, the DHS data used in this study are reasonably reliable.

Women ages 15-49 years constitute the units of analysis for this study. The Ethiopia DHS allowed the collection of information on the birth history of individual women. The birth history information contains relevant demographic information on each child such as sex, date and year of birth, whether that child is alive or dead and age at death. The sample women are divided by parity and further disaggregated into two groups of interest, i.e. urban and rural. Analysis is restricted to the first four parities in order to allow sufficient cases when the sample is further subdivided along the various covariates.

Dependent variables

The dependent variables for this study are durations, measured in months, between successive births. In the DHS the year and month when an event occurred was reported for most age related variables, such as respondent's age, date of first marriage, and dates of births from first to the *nth* birth. Based on this information the variables were transformed into Century Month Code (CMC). The CMC indicates the number of months elapsed since the beginning of the past century, which in the case of the 2000 ETDHS refers to months since the year 1900. The intervals between successive births were calculated by subtracting the CMC of the immediate previous birth from the CMC of the current birth. For the first birth, however, this interval is the length of time between age 10 and a woman's age at first birth. The conventional origin point age 15, which we observe in most fertility studies, is not used in this study. If age 15 is used as an origin point, nearly 5 percent of births will be excluded from the analysis. In order to make use of information on all births this study used age 10 as an origin in the analysis of first births.

The durations between successive births can also be seen as survival times since last birth for second order and higher births. In the case of first birth, this duration is the survival time between age 10 and the date of respondent's first birth. Women may or may not have experienced births within each of these intervals up until the time of the survey. Those women who have not experienced the event are said to be right censored and their exposure time is accounted from the time they are exposed to first birth, i.e. from age 10 to the date of the survey. Although information is lacking on whether and when the event of interest has occurred for right censored cases, the use of parametric hazard model allows their exposure time to be taken into account. Thus, the estimated hazard models assume that the process governing censoring and the risk of births are independent of one another **(**Hosmer and Lemeshow, 1999).

Various models examining the transition to the next higher order birth were estimated, since women who are exposed to the next higher order birth are those who had an immediate lower birth order. For instance those who are exposed to the second birth are those who already had a first birth. These transitions are examined for urban and rural areas by fitting separate models.

Independent variables

It is known that the risk of experiencing a given birth varies for women according to the various attributes they manifest. In order to capture the net effects of each of these variables this study employs multivariate analysis. In the past, various studies have identified different variables that potentially determine fertility. Along the lines of these studies, we control for some of the variables which are further described in the following sections.

Following earlier researchers (Gyimah, 2001, St. Bernard, 1992), age cohort is included in all the models to capture the factors that could differently affect the generations over their life course. The assumption is that women who belong to certain cohorts would have been exposed to similar macro level experiences. The older cohort is expected to have shorter transitions times and a higher risk of subsequent births.

The type of union for women might also have some influence on fertility. In the ETDHS it was noted that about 14 percent of married Ethiopian women are in polygynous unions (CSA & ORC Macro, 2001). At macro level, polygyny can be associated with high fertility since it tends to increase the proportion of women who are in a married state, which in turn exposes them to the risk of childbearing (Lardoux & Van De Walle, 2003). At micro level, polygyny may reduce fertility mainly through reduced frequency of sexual intercourse (ibid, 2003). We expect those women in polygynous unions and the never married to have a longer birth interval.

The relationship between child mortality and fertility has been investigated widely and research findings show that the experience of child loss contributes to changes in reproductive behavior among individuals. That is, women who experienced child loss may intentionally replace lost children, compared to those whose children have survived (LeGrand et al., 2003, Gyimah, 2005). In general, as the chances of child survival increases, its effect on the behavior of individuals in terms of replacing a lost child tends to diminish. It is expected that for those who experienced a recurrence of child death, the risk of birth would be higher and that they will have a shorter birth interval.

Age at first marriage is an important variable in most fertility studies since it indicates the beginning of a woman's exposure to sexual intercourse and hence to the risk of childbearing. Early age at first marriage implies an early initiation of one's reproductive career and a longer exposure time to childbearing, while late age at first marriage implies delays and shorter exposure time to childbearing. Women who marry early are expected to have shorter durations to subsequent births. Never married women would have longer duration.

Age at first birth, which relates to age at first sexual intercourse or age at first marriage, also has some influence on lifetime fertility. Like early age at first sexual intercourse or age at first marriage, early age at first birth implies a longer reproductive lifespan and subsequently higher lifetime fertility. Given that, in Ethiopia, more than 50 percent of women of age 30 and above had their first birth in their teens (CSA & ORC Macro, 2001) this variable is included for the models that estimated the risk of second and higher order births. It is hypothesized that women who had their first birth at a relatively younger age would have shorter transition times to subsequent births.

The level of use of contraception and its efficacy directly relates to fertility. In a situation where contraceptive use is widespread and women are practicing efficient methods, low fertility is a norm. In the DHS women reported the number of children they had at the time they adopted contraception for the first time. This provides a crude measure of contraceptive practice within a given birth interval, i.e., before the first birth, second birth and so forth. We control for contraception initiation in the model that estimates the risks of having first and second births. Due to the small number of cases, it was not possible to include this variable in the models that estimated the timing of third and fourth births. It is expected that the transition to first and second births would be faster for those who did not initiate contraception within the interval.

Female education is expected to reduce desired fertility by making women more receptive to modern social norms, reducing dependence on children for status and social security, and increasing the opportunity cost of time (Dreze and Murthi, 2001). The mechanism through which education affects fertility can work in different ways. When women spend longer time in school they postpone their marriage and childbearing reducing their exposure time. Educated women are also better positioned to have an enhanced knowledge of contraception and are highly likely to adopt an efficient method. Another argument is that educated women face lower risk of infant and child mortality and as a result, they settle for fewer births. We hypothesize that with increased level of education, the risk of childbearing for higher order births for women will decrease.

Studies done in both developed and developing countries document that religion influences the demographic behavior of people (Lehrer, 2004, McQuillan, 2004). Some religions provide psychological and social incentives to couples who have many children, in the form of approval, social status and blessings (Lehrer, 2004). There is some evidence that fertility rates tend to be higher among Muslims than other groups in India (Dreze and Murthi, 2001). A similar trend is observed by Goldscheider (1999) for Israeli Muslims. In order to examine whether there exist fertility differentials among women who belong to different faiths, this study included religion in all the models. It is coded as 1) Orthodox Christians, 2) Protestants 3) Muslims 4) Traditional and others. The last category is dropped from the urban model due to small number of cases. Among the

followers of the two dominant religions of the country, we expect that Muslims would have faster transitions to the next birth compared to Orthodox Christians.

Ethnicity is included in the models with the intention of capturing the influence of unique cultural practices and customs on the reproductive behavior of the members of a given sub population. Ethiopia is referred as a "mosaic of nations and nationalities" with over 80 ethnic groups each with its own unique cultural and linguistic features. Thus, it would be reasonable to expect some kind of variation in the fertility behavior of women belonging to different ethnic groups. Past studies also show the presence of completed fertility differentials by ethnic origin (Kinfu, 2001). We expect Oromos and Somalis to have shorter timing of births compared to Amharas.

Methods of regression analysis

As indicated earlier, the DHS provides valuable birth history information on the timing of each birth that had occurred to individual women. Data are also available on the socio-economic and cultural backgrounds of women, gender and survival status of each birth. These data permit us to estimate event history models which allow a dynamic analysis of the childbearing transitions. In addition, unlike life table analysis, event history models allow the inclusion of other substantively relevant covariates to explain the *risk* of experiencing the event under study. The hazard of an event occurring can be interpreted as the instantaneous probability that an event will occur in a given interval, provided that this event has not occurred before the beginning of this interval (Blossfeld et al., 1989:31). In our case, the hazard of experiencing the first birth applies to women of age 10 and above. For second and higher order births, the hazard of experiencing parity *i+1* refers to those who already had parity *i*.

Event history data, as the case in the DHS, are mostly gathered retrospectively, which introduces the issues of *selectivity* and *censoring*. Selectivity implies, among others, that respondents of retrospective surveys are survivors. Censoring refers to cases who did not experience the event of interest within the observation period. In our case, the DHS collected partial information on the maternity history of women at the date of the survey. We consider those who did not experience the event by the survey date as being *right censored*. Employing event history models would be the most appropriate analytic strategy in order to allow the inclusion of censored information (Blossfeld et al., 1989, Willett & Singer 1995, Singer& Willett 2003). Event history analysis may take non-parametric, semi-parametric or parametric forms. The life table technique is a non-parametric analytic strategy, which does not allow the simultaneous inclusion of covariates to examine their influence on the timing of births. The Cox (1972) proportional hazard model is a semi-parametric model which allows controlling for a set of covariates without specifying the hazard function. Unlike the Cox model, the parametric survival models require the specification of the hazard function. The parametric hazard models assume that the underlying timing function follows some known mathematical distribution. For this study, a log-normal distribution is chosen, which assumes a non-monotonic hazard rate that initially increase and then decrease (Blossfeld and Rohwer, 2002). This choice is guided by both its theoretical relevance and visual inspection of graphical representation of the hazard rates. The log-normal hazard *h(t)*, survival *S(t)*, and density *f(t)* functions can be expressed as :

[1] $$h(t) = \frac{\frac{1}{t\sigma\sqrt{2\pi}} \exp\left[\frac{-1}{2\sigma^2}\{\ln(t) - \mu\}^2\right]}{1 - \Phi\left\{\frac{\ln(t) - \mu}{\sigma}\right\}}$$

[2] $$S(t) = 1 - \Phi\left\{\frac{\ln(t) - \mu}{\sigma}\right\}$$

[3] $$f(t) = \frac{1}{t\sigma\sqrt{2\pi}} \exp\left[\frac{-1}{2\sigma^2}\{\ln(t) - \mu\}^2\right]$$

Where;

$\Phi(z)$ is the standard normal cumulative distribution;
σ is the standard deviation of the normal distribution, and
μ is the mean.

The log-normal hazard model is estimated using STATA which allows maximum likelihood estimation. STATA provides the option for the log-normal model to be estimated in terms of either the proportional hazard metric, as in the Cox model, or in accelerated time failure (AFT) metric which produces time ratios. In this study, the parametric models are estimated using time ratios. For each covariate, a time ratio value greater than one can be interpreted as individuals in that particular category experience the event at a later timing, compared to those in the reference category of a given covariate. Conversely, a time ratio value of less than one implies that individuals with a particular attribute will experience the event of interest faster than those in the reference category. The overall significance of the models is assessed using the log-likelihood ratio statistic.

Findings

Descriptive statistics

Table 1 presents the demographic, proximate, and socio-cultural characteristics of women who were considered in the analysis of the various birth transition processes. The table also shows the distribution of women according to their place of residence along with the covariates of interest in this study.

Table 1 about here

A total of 15, 364 women (30% of them urban & 70% of them rural residents) were at the risk of having first birth. Overall, two thirds of these women experienced the event. Of those exposed to the risk of first birth, more rural women (72%) compared to urban (51%) had their first birth. Among the 10,140 women who were exposed to the risk of having second births, the percentage of women who attained parity two is lower for urban areas (73 %) compared to rural areas (85%). The 8378 women who had second births were at the risk of having a third birth. Of these number of women, 6774 or 81 percent of them had experienced the event. Once again, it is only 72 percent of women from urban areas that went to have a third birth compared to 83 percent from rural areas. Among those exposed to the risk of a fourth birth 81, 73, and 82 percent of them at the national, urban and rural levels have experienced the event respectively.

Turning to the type of union of those exposed to first birth, 53 percent of women were in monogamous unions, 9 percent in polygynous, 13 percent were formerly married and 26 percent were never married. Across all transitions, women in monogamous unions constitute the larger proportion. A slightly higher proportion of rural women compared to urban are in monogamous unions. The percentage distribution by type of union also indicates that while polygynous union is widely practiced by rural women the "never married" are concentrated in urban areas particularly among those who were exposed to first births.

Among those who were exposed to the risks of second to fourth births, largest percentage have married for the first time when they were 16 years or younger. The pattern is similar for both urban and rural areas. With regard to contraceptive use, in both urban and rural areas, it is only 6 percent of women who used contraception before their first birth. A similar percentage of women used contraception before they had their second birth. However, more urban women were contraceptive users than rural women.

On the survival status of the previous children, about 24% of women who were exposed to second births experienced the death of their first child, although rural women experience the larger proportion of child deaths. In the case of the survival status of the previous three children, for those exposed to the risk of fourth birth, the distribution shows urban women have lost less children than their rural counterparts.

The majority of women (69 %) exposed to the risk of first birth had no education, while 16 and 15 percent of them had some primary and some secondary or higher level of education. This picture varies for urban and rural areas. Three quarters of rural women had no formal education while it is almost one in two women from urban areas with the same level of education indicating better chances of educational attainment for women from urban areas.

In terms of religion, Orthodox Christians followed by Muslims make the largest proportion while Protestants and members of other faiths constitute small percentage of women at the risk of various parities. The descriptive statistics reveal that two thirds of urban residents are Orthodox Christians and another quarter are Muslims. Comparatively rural areas had equal proportion of Orthodox Christians and Muslims.

Ethnic distribution of women associated with the risk of having first to fourth births show that the largest are the *Amhara* and *Oromo* ethnic groups. The percentage of women from urban areas who belong to the *Amhara* ethnic group is twice that of rural areas across all births. Compared to urban areas, a slightly higher proportion of rural

women belong to the *Oromo* ethnic group. *Tigrawis*, the third largest ethnic group in this sample, made up about 10 percent of cases and most are from rural areas.

Median ages at different parities and median duration between births

Table 2 presents observed and estimated median ages of women at different births. Estimated values are derived from life table analysis that takes into account censored cases, making these more reliable than the observed values. For all parities, the estimated median ages are higher than the observed values. As shown in Table 2, about 50 percent of women in Ethiopia had their first birth by age 20. The results indicate that on average, at the national level, there is a difference of over two years between median ages of women at subsequent births.

Table 2 about here

As expected, median ages at birth of urban women are higher than those of rural women across parities. This difference is more pronounced for the first birth, where the differnce is over two years. The difference between median ages of urban and rural women slightly decreases at higher order births. Overall, on average median ages of urban women are higher than those of rural women by about a year and half for parities one to four.

Median durations in months between respondents' 10^{th} birth day and the dates of their first births and between successive births are presented in Table 3. Like the median ages, estimated durations are higher than observed durations for all transitions. Also, as these estimates are obtained using life table techniques the estimates are more reliable than the observed values.

Table 3 about here

Examining the durations between successive births beginning from first birth indicates that rural women on average have a 4 month shorter transition time to the next birth, compared to urban women. For urban women, median durations between births are above 36 months for the first two transitions and above 35 months for the transition from third to fourth births. The median duration between age 10 and the respondent's first birth is much longer (higher by over 30 months) for urban women, compared to women from rural areas.

Overall younger median age at first birth at the national and sub-national levels go with the expectations from the culture that encourages childbearing at younger ages. Also, newlyweds receive the pressure and blessings from the society to give birth soon after they marry. Delay in having subsequent births, as evidenced by the longer duration between successive births, is also according to expectation in a culture where breastfeeding is widely practiced.

Bivariate relationships

Log normal accelerated failure time models were estimated to examine the relationship between each covariate and the timing of subsequent births (appendix 1).

Two preliminary conclusions can be drawn from the bivariate findings. First, the association between demographic and proximate variables and the timing of subsequent births are consistent and strong across all transitions. The only exception to this pattern is the association between the variable age at first birth and the timing of successive births. Similarly, socio-cultural variables show significant association with the transition to subsequent births. The bivariate analysis showed that for all parities rural women have a significantly shorter transition time to the next birth.

Although the bivariate findings provide indication of the relationship between the dependent and independent variables they do not take the effects of other relevant variables into account. In order to determine the net effects of each covariate, and adjusting for the effects of others, we now turn to multivariate analysis. In addition, the multivariate analysis estimates separate models to examine the effects of covariates on the timing of births for urban and rural women.

Multivariate parametric hazard models of the effects of various covariates on the timing and spacing of births

The results from the multivariate analyses are presented in Table 4 to Table 7 for the transitions to first, second, third and fourth births. Two separate models are estimated for each transition. The first model controls for demographic and proximate variables. The second model, which is the full model, adds socio-cultural variables to the first model. By comparing these models we can determine whether the relationship between the timing of births and the demographic and proximate factors is maintained when the socio- cultural variables are included.

First birth

Table 4 presents the results of the timing of first births and the covariates that are expected to have some impact on this process for urban and rural areas. The negative log-likelihoods and Chi-Square statistics indicate that the overall models are significant.

Table 4 about here

With the exception of age cohort, all demographic and proximate covariates in Model 1 have significant association with the first birth process in both rural and urban areas. With respect to the type of marital union, the formerly married and the never married significantly differ from those in monogamous union in their transition to the first birth. In particular, the never married in both urban and rural areas take three times longer time to make the transition to first births compared to those in monogamous union. Similarly, the formerly married in both rural and urban areas show a significantly longer transition time to first birth compared with those in monogamous unions. The length of this duration is comparatively longer for rural women. Also, rural women in polygynous unions have a three percent longer duration time to first birth compared to those in monogamous union. This is not the case for urban women.

As expected, women whose first marriage has occurred at a relatively later time have a significantly longer timing to first birth in both urban and rural areas. However, the duration is higher for urban than rural women. For instance, while urban women who had their first marriage by age 17 and later have a 61 percent longer duration to first birth

compared to those who were married by age 16 and under, this transition time is only 49 percent longer for rural women. Also, compared to those who did not use contraceptives, the transition time to first birth is longer by 29 percent in urban and 16 percent in rural areas for those who used some form of contraception before the first birth.

Model 2 for both urban and rural areas show significant improvement over Model 1 as evidenced by the higher likelihood ratio and model Chi-Square statistics. There is no substantial change in parameter estimates and the direction of influence between the two models, indicating the strength of the association between the Model 1 covariates and the transition to first birth.

Examining the effects of socio-cultural variables suggest that the timing of first births in both urban and rural areas is slightly different for women with secondary or higher level of education compared to those with out any formal education. However, the direction of the effect is not as expected. That is, women with secondary and higher level of education have faster transition to first births. Most of these women (41%) are from the older cohort. The quicker transition might be the result of an attempt to compensate for the time spent at school. In terms of the effect of religion on the timing and transition to first births, urban Muslim women have slightly longer transition to first birth relative to Orthodox Christians. Although the direction of the relation is similar to that of urban women, for rural women the magnitude is lower. There is also significant difference in the timing of first births with respect to ethnic origin of women. Compared to *Amharas*, *Oromos* show shorter transition time and by implication higher risk of first births. This pattern applies to both urban and rural settings. The difference in the timing of first births between those who belong to other ethnic groups and *Amharas* is not significant in urban settings.

Second birth

Table 5 presents the results from the multivariate analyses on the effects of selected theoretically relevant covariates on the timing of second births. Based on the negative log likelihood values from each model, it is evident that the overall model is significant. Model 1 controls for age cohort, union status, contraceptive use, age at first marriage, age at first birth and the survival status of the first child. The full model includes covariates from Model one and additional socio-cultural variables.

Table 5 about here

In Model 1, significant differences in the timing of second births for urban and rural residents are observed according to age cohort, type of union, contraceptive use, and the survival status of the previous child. Of the remaining demographic and proximate variables in Model 1, significant differences in the timing of second births for rural residents are observed with respect to age at first marriage and age at first birth.

Unlike the previous model of first births, the age cohort variable shows a significant relationship in the expected direction with the timing of second births. In both rural and urban areas young women show a significantly longer duration to second births compared to women aged 35 and above. However, this duration is by far longer for urban women compared to rural women. Also, the estimated time ratios suggest that women in urban areas who are in polygynous union, the formerly married and those never married have a significantly longer transition to second births which implies later timing. The

results also show that, although rural women exhibit the same pattern, the magnitude of the transition time is lower compared to urban women. For instance, compared to women in monogamous unions, in rural areas those in polygynous unions have three percent longer transition time to the second birth relative to 17 percent for urban women. Similarly, compared to those in monogamous unions, the never married women from rural areas show a 60 percent longer transition to the second birth while in urban areas never married women show three times longer transition.

The transition to second birth is quicker by five percent for rural women who married after age 17, compared to those who married when they were 16 years and younger. Compared to those who had their first birth when they were age 18 and below the transition time to second birth is longer by three percent for rural women who had their first birth by age 19 and after. As expected, the transition time to the second birth is longer for contraceptive users compared to non users. However, urban women have longer transition and hence lower risk to second birth compared to women from rural areas. Compared to women whose first child survived, the transition to second birth is faster by about 13 percent for urban and by 22 percent for rural women who lost their first child.

Model 2 improves considerably on Model 1. Just like the first birth, in the urban models, education is found not to have significant effect on the transition to second births. However, in rural areas women with primary education show a slightly longer transition to second births compared to those in the reference category. In both urban and rural areas the timing of the transition to second births is significantly quicker for Muslim women compared to Orthodox Christians. However, it is even faster for urban than rural women. Rural women who follow Protestantism have longer transition time to second births compared to their Orthodox counterparts. With regard to ethnicity, its effect on the transition to second births is significant in both urban and rural areas. Compared to *Amharas*, *Oromo* women from urban and rural areas are 10 and 17 percent faster to make the transition to the second birth. *Guraghie* women from rural areas have 14 percent quicker transition to second birth compared to women of *Amhara* ethnic origin. Women who belong to the *Somalie* ethnic group have a 31 and 28 percent quicker transition, in urban and rural areas respectively, to the second birth compared to women from the *Amhara* ethnic group. While *Affar* women from rural areas have shorter transition time to second births, women who belong to the "other" category make a faster transition in both urban and rural areas.

Third birth

The time ratios from the parametric hazard models that estimated the effects of substantively related covariates are presented in Table 6. Different from the first and second births, the models that apply to the third birth exclude the contraceptive use variable due to insufficient number of cases. The likelihood ratio tests suggest that both Model 1 and Model 2 are significant.

Table 6 about here

In Model 1, there is no apparent difference in the transition to the third birth between those who marry early and late. In the same manner, there is no significant

difference in the transition to the third birth between those who had their first birth when they were 18 and younger and those ages 19 and older. These patterns hold for women from urban and rural areas. As expected, women from the young and middle cohorts have longer transition times to third births. However, the difference is significant and more pronounced for urban women. For example, compared to older women the young cohort from urban centers show a 59 percent longer transition time compared to 6 percent for rural women.

A look at the type of union suggests that compared to women in monogamous marriages, those in polygynous unions from rural areas have a 4 percent longer transition time to the third birth. Although, the direction of the effect is similar for urban areas it is not significant. Rural formerly married women in both rural and urban areas show longer transition time to third birth compared to those in monogamous unions. Women who experienced the death of one or both of their previous children have a significantly faster transition to third births in both urban and rural areas, which is according to expectation. In Model 1, urban women who lost a child or children make a slightly faster transition to the third birth compared to rural.

Model 2 significantly improves on Model 1. Except age at first marriage (for both urban and rural areas) and age at first birth (only for rural areas) all covariates show significant effect on the transition to third births. Compared to Model 1, in the urban Model 2 the effect of the age cohort variable becomes stronger while it maintains a similar level of influence in rural areas. That is, the coefficient for the urban model changed from 1.59 in Model 1 to 1.77 in Model 2 and for the rural model this coefficient is 1.06 for both models. The inclusion of socio-cultural variables has made the effect of age cohort even stronger for the urban model.

Turning to the type of union, the coefficients of this covariate has changed considerably from Model 1 to Model 2 and this change is more pronounced for the urban model. In the case of urban areas, compared to women in monogamous unions, the formerly married show 39 percent longer transition to the third birth while rural women have a 11 percent longer transition time. Also, urban women in polygynous unions take a 22 percent longer transition time to the third birth compared to those in monogamous unions. In contrast, rural women in polygynous unions have an 8 percent longer transition to third birth compared with women from the reference category.

A look at the effect of the survival status of previous children reveals that rural women whose previous two children had died make a 23 percent quicker transition to the third birth compared to those whose children have survived. In urban settings those who lost one of their two children are 17 percent faster to have a third birth compared to those who did not lose any child.

For religion, using Orthodox Christians as the reference category, Muslims continue to have shorter transition time and hence higher risk of third births in both urban and rural areas. However, the magnitude is more noticeable in urban areas. Women who belong to the Protestant religion have shorter timing in urban settings. Turning to ethnicity, there is a significant difference in the transition to third birth between Amhara and the other ethnic groups. *Oromo* women have 15 and 12 percent quicker timing to third births in urban and rural areas respectively compared to *Amharas*. Similarly, compared to *Amharas*, *Guraghie* women have 25 and 9 percent faster transition times to third birth in urban and rural areas respectively. The quickest transition to the third birth

is observed for *Somalie* women in both urban (41 %) and rural (26 %) areas in comparison to women from the *Amhara* ethnic group.

Fourth birth

Table 7 presents the results of the effects of the covariates on the transition to fourth birth. Like the models from first to third births, the negative log likelihood and the related likelihood ratios indicate the overall models as significant.

Table 7 about here

Taking those ages 35 and above as the reference category, women from the next younger cohort have a 28 percent and 4 percent longer transition times to the fourth birth in urban and rural areas respectively. The effect of the type of union persisted in the transition to the fourth birth. Compared with women in monogamous unions, the formerly married have a 27 percent longer transition to the fourth birth in urban areas and 12 percent longer transition time in rural areas.

There is a significant difference between those who have child death experience and those who have not in the transition to the fourth birth. For instance, in urban areas as compared to those whose three previous children survived, those with no surviving children have 38 percent faster transition time to the fourth birth (Model 1). In rural areas women who lost all their previous children have a 27 percent quicker timing to the fourth birth.

As evidenced by the negative log likelihood and the likelihood ratio tests, Model 2 has greatly improved on Model 1. For instance for the urban model, the magnitude of the difference between the intermediate and older cohorts has changed from 1.28 in Model 1 to 1.37 in Model 2. In terms of the effect of the survival status of previous children, the coefficients have changed slightly more for the urban model than the rural model.

Coming to the socio-cultural covariates, the effect of education on the timing of fourth births is observed for the rural model and it is significant. With respect to religion, there is a significant difference between Orthodox Christians and Protestants, between Muslims and Orthodox Christians in both urban and rural areas. Muslims continue to have shorter transition times to the fourth birth compared to Orthodox Christians and the magnitude is slightly higher for urban areas than rural. Protestants from urban areas show a 27 percent longer transition to the fourth birth. Although their rural counterparts show a similar trend the effect is not significant. Like the previous models *Oromos* in rural areas have shorter transition to the fourth birth compared to *Amharas*. The same pattern is observed in urban areas although the effect is not significant.

Discussion

The life table analysis suggested that about half of women had their first births by age 20. For all parities, other than the first, the median ages of urban women are higher by over a year and half compared to rural women. Similarly, results from the life table analysis indicated that rural women on average had 4 months shorter transition time to the next birth compared to urban women across all parities. For urban women, median

durations between births are above 35 months for all transitions. These results clearly indicate that urban women are having longer transition times to the next birth which also implies lower risk of births. This is in accordance with theoretical expectations.

The effects of theoretically relevant covariates in the timing of subsequent births are also assessed using parametric hazard models. The bivariate analysis results show that there are significant variations in the timing of subsequent births by demographic, proximate, and socio-cultural attributes of respondents. In the bivariate analyses, except for age at first birth and in the case of third and fourth births, the remaining covariates are significantly associated to the timing of births.

The results from the multivariate analysis suggested that the effects of these covariates are in accordance with the suggestions from the literature. The results showed that age cohort has significant effect on the timing of successive births. Women from the younger and intermediate cohorts take longer transition time to the next birth compared to those from the old cohort. For this younger and intermediate cohort this transition time also increases from the first to the second and third births relative to older cohort and particularly for urban women. This can be interpreted in terms of the opportunity and the motivation to use contraceptives, a relatively improved access to information through the media, and the chance to attend formal education, which in turn allows the young cohort to delay marriage or space births. This was confirmed by the results showing that the effect is much stronger in urban settings where more opportunities are available. In the urban environment, young people tend to have longer transition times to successive births. The time they take out of their reproductive life span might be invested in developing their human capital or preparing themselves to shoulder the responsibility of parenting. The societal norm in terms of pressuring young people to marry and have kids at an early age, as it was during the times of the older cohorts, have began to change and young people are now relatively free to decide for themselves. This point has also been underpinned repeatedly by the respondents of the qualitative interview. These factors are thought to be behind the later timing of subsequent births for women from young cohort compared to the old.

The timing of births is significantly associated with the type of union. As expected, the formerly married and the never married spend longer time to move into the next birth compared to those in monogamous union. Also this effect is stronger for urban areas. This is according to the theoretical expectation that most births occur within marriage. Polygyny is also found to extend the length of time to the next birth. This might be due to the reduced frequency of sexual intercourse as explained by some researchers (LeGrand et al., 2003).

The role of contraception in fertility change has been well established. In this study contraceptive use is directly controlled only for the first and second birth transition processes. As expected, those who used contraceptives before the birth of their first child and those who used in between the first and second birth intervals have a significantly longer transition to first and second births respectively compared to those who have not used contraception. Also the effect is stronger in urban areas. This may not be surprising since contraceptives are better accessed in the urban environment. Also, net of other factors, late age at first marriage is related to later transition to first births.

The impact of child survivorship on subsequent fertility behavior has been the subject of much previous research by demographers (for example Preston, 1978; Cleland

and Wilson, 1987; Defo, 1998; Gyimah, 2001). The findings from this study confirm that women with child loss experience have faster transition to the next birth. The pace of this transition accelerates with the number of child deaths women have experienced. For instance, compared to women whose three previous children are alive, those with no surviving children have a much accelerated transition to the fourth birth. In urban settings, those who lost their first born have a 16 percent faster timing to the second birth, whereas rural women with similar experience have a 25 percent quicker transition relative to those whose first born survived. In the case of the models that assessed the timing of second births, the mechanism through which a child death affects subsequent birth might be through early discontinuation of breastfeeding. Physiologically, prolonged breastfeeding is known to delay ovulation and the resumption of menstruation. Infant death leads to the discontinuation of breastfeeding which in turn accelerates the return of ovulation and the risk of conceiving the next child. The faster transition to higher order births observed among those who lost one or more of their previous child(ren) can also be attributed to intentional replacement of dead children. Based on census data, Kinfu (2001) noted that in Addis Ababa completed fertility is higher among women who experienced the death of two or more children than those who lost only one or none. Overall, the effect of child loss on the timing of subsequent births is more pronounced in rural areas in the case of second and third births and this pattern changes when it comes to the fourth birth. That is the effect is slightly higher in urban areas compared to rural.

Turning to socio-cultural covariates, fertility studies consistently show that parental education, particularly that of maternal education, as the most important determinant of reproductive behavior (Cochrane, 1983, Cleland & Rodriguez, 1988). In this study, primary education and the timing of births are observed to be inversely associated for the second and fourth births and for rural areas. These findings suggest that the more a woman is educated the longer she delays her transition to subsequent births. However, the effect of education is not significant for the urban models suggesting that there are no significant differences between women with some level of education and others with No formal education. This result may be a function of the focus on timing, here urban women with more education may have their children more quickly, but have fewer total children.

Religion and ethnicity are significantly associated with the timing of subsequent births. With respect to religion, with the exception of the first birth, Muslims are observed to have shorter birth intervals across all transitions compared to Orthodox Christians. On the other hand, Protestants are found to have later transition and hence lower risk to subsequent births compared to Orthodox Christians. These findings are corroborated by the findings from an earlier study (Kinfu, 2001). However, the same study found that this difference disappears once other socioeconomic variables are controlled. The present study did not control for socioeconomic factors, other than education, to test for a similar hypothesis. Perhaps, the differential in the timing of subsequent births between Protestants and Orthodox Christians can be explained by the values and attitudes these two groups hold. Orthodox Christians, in general, uphold conservative views and ideas regarding many different aspects of life including reproductive matters. Conversely, Protestantism entered the country much later and it was introduced by foreign missionaries who brought with them different ideas and views. For instance, some protestant churches embrace contraceptive use and the supply of

contraceptives is included in their development programs. In comparison, the Orthodox Church does not support contraception.

With respect to ethnicity, *Oromo*s are observed to have shorter birth intervals across all transitions compared to *Amhara*s. No significant difference is observed in the timing of successive births between *Tigrawi* and *Amharas*. These two ethnic groups trace their roots to the Semitic stock and largely followers of Orthodox Christianity. On the other hand the *Oromo* belong to a different stock and compared to the *Amhara* and *Tigrawai* most follow Islam. These similarities and differences perhaps partly explain the difference in the timing of births between ethnic groups. The cultural practices these ethnic groups follow might also explain the differences. The *Oromo* have a long established system of adoption which is widely practiced by their members. It is not uncommon among the *Oromo* to give children for adoption as well as to adopt from others including from non-*Oromos*. This practice may provide the motivation for the *Oromo* women to make faster transition to the next births.

References

Blossfeld, H-P., Hamerle, A. and Mayer, K.U. (1989). *Event history analysis: Statistical theory and application in the social science*. Hillsdale, NJ: Lawrence Erlbaum Associates, Publishers.

Blossfeld, H-P. and Rowher, G. (2002). *Techniques of event history modeling: New approaches to causal analysis*. London: Lawrence Erlbaum Associates.

Bongaarts, J. (2002). The end of the fertility transition in the developing world. Policy Research Division Working Paper, 161. New York: Population Council.

Cleland, J. (2001). The effects of improved survival on fertility: A reassessment. In Bulatao, R.A. and Casterline, J.B. (Eds.), Global Fertility Transition. *Population and Development Review*,(Pp. 60-92), Supplement to Vol.27.

Cleland, J. and Wilson, C. (1987). Demand theories of the fertility transition: An iconoclastic view. *Population Studies* 41(1),5-30.

Cleland, J. and Rodriguez, G. (1988). The effect of parental education on marital fertility. *Population Studies*, 42(3), 419-442.

Cochrane, S.H. (1983). Effects of education and urbanization on fertility. In Bulato, R. and Lee, R. (Eds.), *Determinants of fertility in developing countries. Viol.1. Supply and demand for children*, (pp. 587-626). New York: Academic Press.

Central Statistical Authority [Ethiopia] and ORC Macro International Inc. (2001). *Ethiopia: Demographic and Health Survey 2000.* Addis Ababa, Ethiopia and Calverton, Maryland, USA.

Cox, D.R. (1972). *Regression models and life tables (with discussion). Journal of the Royal Statistical Society,* Series B, 34, 187-220.

Davis, K. (1963). The theory of change and response in modern demographic history. *Population Index,* 29 (4), 345-366.

Defo, B. Kuate (1998). Fertility response to infant and child mortality in Africa with special reference to Cameron. In Montgomery, M. R. and Cohen, B., (Eds.), From death to birth: mortality decline and reproductive change. Washington, D.C.: National Academy Press.

Dreze, J. and Mamta, M. (2001). Fertility, education and development: Evidence from India. *Population and Development Review* 27 (1), 33-63.

Goldscheider, C. (1999). Religious values, dependencies, and fertility: Evidence and implications from Israel. In Leete, R. (Ed.), *Dynamics of Values in Fertility Change* (pp310-330). Oxford: Oxford University Press.

Gyimah, S. O. (2001). *Childhood mortality and reproductive behavior in Ghana and Kenya: An examination of frailty and non-frailty models*. Unpublished PhD. Dissertation, University of Western Ontario, London, Ontario.

Gyimah, S. O. (2005). The dynamics of timing and spacing of births in Ghana. *Journal of Comparative Family Studies;* 36 (1) ,41-60

Hosmer, D.W. and Lemeshow, S. (1999). *Applied survival analysis: Regression modeling of time to event data*. New York: John Wiley and Sons, Inc.

Kinfu, Y. (2001). *The quite revolution: An analysis of the change toward below replacement level fertility in Addis Ababa*. Ph.D. thesis, The Australian National University.

Lardoux, S. and Van De Walle, E., (2003). Polygyny and fertility in Senegal. Population, 58 (6), 717-744.

LeGrand T., Todd K., Mondain, N., and Randall, S. (2003). Reassessing the insurance effect: A qualitative analysis of fertility behavior in Senegal and Zimbabwe. *Population and Development Review* 29 (3), 375-403.

Lehrer, E. (2004). Religion as a determinant of economic and demographic behavior in the United States. *Population and Development Review* 30 (4), 707-726.

McDonald, P. (2000). Gender equity in theories of fertility transition. *Population and Development Review* 26 (3), 427-439.

McQillan, K. (2004). When does religion influence fertility? *Population and Development Review* 30 (1), 25-56.

Notestein, W.F. (1945). Population: the long view. In T. W. Schultz. (Ed). *Food for the World*, (pp.36-57), Chicago: University of Chicago Press.

Preston, S.H. (1978), *The effects of infant and child mortality on fertility.* New York: Academic Press.

Shah, N. M. and Nathanson, C. A. (2004). Parental perceptions of costs and benefits of children as correlates of fertility in Kuwait. *Journal of Biosocial Science,* 36, 663-682.

Sibanda, A. Woubalem, Z., Hogan, D. and Lindstrom, D.D., (2003). The proximate determinants of the decline to below replacement fertility in Addis Ababa, Ethiopia. *Studies in Family Planning*, 34(1), 1-7.

Singer, J.D. and Willett, T.B. (2003). Applied longitudinal data analysis: modeling change and event occurrence. New York: Oxford University Press.

Spengler, J.J. (1979). *France faces depopulation: Postlude Edition, 1936-1976.* Durham, N.C.: Duke University Press.

St. Bernard, G.C. (1992). *Relative risks and tempo of childbearing in early birth intervals: A comparative study of the Dominican Republic and Trinidad and Tobago*. Unpublished PhD. Thesis. University of Western Ontario, London Ontario.

Willett, J.B. and Singer, J.D. (1995). Investigating onset, cessation, relapse, and recovery: Using discrete-time survival analysis to examine the occurrence and timing of critical events. In Gottman, J.M. *The analysis of change*, (pp.203-259). Mahwah, NJ and Hove, UK.: Lawrence Erlbaum Associates, Publishers.

Table 1: Number and percentage (in bold) of women ever exposed to risks of 1st - 4th births by place of residence and other covariates, Ethiopia, 2000

Covariates	First births			Second births			Third births			Fourth births		
Age cohort	Urban	Rural	Total	Urban	Rural	Total	Urban	Rural	Total	Urban	Rural	Total
35 years & above	1,055	3,264	4,319	986	3,192	4,178	892	3,116	4,008	773	2,991	3,764
	23.2	**30.2**	**28.1**	**42.5**	**40.8**	**41.2**	**52.5**	**46.7**	**47.8**	**63.2**	**53.8**	**55.5**
25 - 34 years	1,360	3,257	4,617	938	3,014	3,952	676	2,730	3,406	419	2,246	2,665
	29.9	**30.1**	**30.1**	**40.4**	**38.5**	**39.0**	**39.8**	**40.9**	**40.7**	**34.2**	**40.4**	**39.3**
15 - 24 years	2,128	4,300	6,428	397	1,616	2,013	132	832	964	32	321	353
	46.8	**39.7**	**41.8**	**17.1**	**20.7**	**19.8**	**7.8**	**12.5**	**11.5**	**2.6**	**5.8**	**5.2**
Union status												
Monogamous	1,727	6,344	8,071	1,505	5,700	7,205	1,156	4,862	6,018	843	4,036	4,879
	38.0	**58.6**	**52.5**	**64.9**	**72.9**	**71.1**	**68.0**	**72.8**	**71.9**	**68.9**	**72.6**	**72.0**
Polygynous	116	1,191	1,307	103	1,106	1,209	79	992	1,071	64	843	907
	2.6	**11.0**	**8.5**	**4.4**	**14.1**	**11.9**	**4.6**	**14.9**	**12.8**	**5.2**	**15.2**	**13.4**
Formerly Married	775	1,232	2,007	629	993	1,622	448	816	1,264	311	675	986
	17.1	**11.4**	**13.1**	**27.1**	**12.7**	**16.0**	**26.4**	**12.2**	**15.1**	**25.4**	**12.1**	**14.5**
Never Married*	1,925	2,054	3,979	83	21	104	16	6	22	5	3	8
	42.4	**19.0**	**25.9**	**3.6**	**0.3**	**1.0**	**0.9**	**0.1**	**0.3**	**0.4**	**0.1**	**0.1**
Age at first marriage												
Age 16 & under	1,374	5,674	7,048	1,206	5,140	6,346	983	4,536	5,519	766	3,888	4,654
	30.2	**52.4**	**45.9**	**52.0**	**65.7**	**62.6**	**57.8**	**67.9**	**65.9**	**62.6**	**70.0**	**68.6**
Age 17 & above	1,244	3,093	4,337	1,032	2,661	3,693	701	2,136	2,837	453	1,667	2,120
	27.4	**28.6**	**28.2**	**44.5**	**34.0**	**36.4**	**41.2**	**32.0**	**33.9**	**37.0**	**30.0**	**31.3**
Never married**	1,925	2,054	3,979	83	21	104	16	6	22	5	3	8
	42.4	**19.0**	**25.9**	**3.6**	**0.3**	**1.0**	**0.9**	**0.1**	**0.3**	**0.4**	**0.1**	**0.1**
Age at first birth												
18 years & under	-	-	-	1,149	4,244	5,393	940	3,794	4,734	734	3,302	4,036
	-	-	-	**49.5**	**54.3**	**53.2**	**55.3**	**56.8**	**56.5**	**60.0**	**59.4**	**59.5**
19 years & above	-	-	-	1,172	3,578	4,750	760	2,884	3,644	490	2,256	2,746
	-	-	-	**50.5**	**45.7**	**46.8**	**44.7**	**43.2**	**43.5**	**40.0**	**40.6**	**40.5**

* This category is dropped from, the multivariate models of third & fourth births, due to small number of observations
* The Never Married category for the first birth process is substantial because this value refers to those who are never married at the time of the survey

** This category is dropped from all multivariate models

Cont'd Table 1	First births			Second births			Third births			Fourth births		
Covariates	Urban	Rural	Total	Urban	Rural	Total	Urban	Rural	Total	Urban	Rural	Total
Contraceptive use												
Not user	3,837	10,636	14,473	1,877	7,613	9,490	-	-	-	-	-	-
	84.5	**98.3**	**94.2**	**80.9**	**97.3**	**93.6**	-	-	-	-	-	-
User	706	185	891	444	209	653	-	-	-	-	-	-
	15.5	**1.7**	**5.8**	**19.1**	**2.7**	**6.4**	-	-	-	-	-	-
Education												
No education	2,361	8,222	10,583	1,253	5,962	7,215	927	5,111	6,038	664	4,279	4,943
	52.0	**76.0**	**68.9**	**54.0**	**76.2**	**71.1**	**54.5**	**76.5**	**72.1**	**54.2**	**77.0**	**72.9**
Primary	1,030	1,500	2,530	497	1,089	1,586	371	917	1,288	268	751	1,019
	22.7	**13.9**	**16.5**	**21.4**	**13.9**	**15.6**	**21.8**	**13.7**	**15.4**	**21.9**	**13.5**	**15.0**
Secondary & higher	1,152	1,099	2,251	571	771	1,342	402	650	1,052	292	528	820
	25.4	**10.2**	**14.7**	**24.6**	**9.9**	**13.2**	**23.6**	**9.7**	**12.6**	**23.9**	**9.5**	**12.1**
Surv. Stat. of prev. chi												
Alive	-	-	-	1,954	5,725	7,679	-	-	-	-	-	-
	-	-	-	**84.2**	**73.2**	**75.7**	-	-	-	-	-	-
Dead	-	-	-	367	2,097	2,464	-	-	-	-	-	-
	-	-	-	**15.8**	**26.8**	**24.3**	-	-	-	-	-	-
Both alive	-	-	-	-	-	-	1,211	3,807	5,018	-	-	-
	-	-	-	-	-	-	**71.2**	**57.0**	**59.9**	-	-	-
Alive 1 dead	-	-	-	-	-	-	406	2,149	2,555	-	-	-
	-	-	-	-	-	-	**23.9**	**32.2**	**30.5**	-	-	-
Both dead	-	-	-	-	-	-	83	722	805	-	-	-
	-	-	-	-	-	-	**4.9**	**10.8**	**9.6**	-	-	-
All alive	-	-	-	-	-	-	-	-	-	730	2,502	3,232
	-	-	-	-	-	-	-	-	-	**59.6**	**45.0**	**47.7**
2 alive 1 dead	-	-	-	-	-	-	-	-	-	351	1,847	2,198
	-	-	-	-	-	-	-	-	-	**28.7**	**33.2**	**32.4**
1 alive 2 dead	-	-	-	-	-	-	-	-	-	116	912	1,028
	-	-	-	-	-	-	-	-	-	**9.5**	**16.4**	**15.2**
All dead	-	-	-	-	-	-	-	-	-	27	297	324
	-	-	-	-	-	-	-	-	-	**2.2**	**5.3**	**4.8**

Cont'd Table 1	First births			Second births			Third births			Fourth births		
Covariates	Urban	Rural	Total	Urban	Rural	Total	Urban	Rural	Total	Urban	Rural	Total
Religion												
Orthodox Christian	3,064	4,348	7,412	1,567	3,210	4,777	1,128	2,730	3,858	784	2,269	3,053
	67.4	**40.2**	**48.2**	**67.5**	**41.0**	**47.1**	**66.4**	**40.9**	**46.0**	**64.1**	**40.8**	**45.0**
Protestant	426	1,673	2,099	188	1,126	1,314	128	938	1,066	95	769	864
	9.4	**15.5**	**13.7**	**8.1**	**14.4**	**13.0**	**7.5**	**14.0**	**12.7**	**7.8**	**13.8**	**12.7**
Muslim	1,036	4,333	5,369	557	3,137	3,694	438	2,708	3,146	341	2,275	2,616
	22.8	**40.0**	**34.9**	**24.0**	**40.1**	**36.4**	**25.8**	**40.6**	**37.6**	**27.9**	**40.9**	**38.6**
Traditional & Other***	17	467	484	9	349	358	6	302	308	4	245	249
	0.4	**4.3**	**3.2**	**0.4**	**4.5**	**3.5**	**0.4**	**4.5**	**3.7**	**0.3**	**4.4**	**3.7**
Ethnicity												
Amhara	2,154	2,276	4,430	1,074	1,744	2,818	769	1,465	2,234	525	1,204	1,729
	47.4	**21.0**	**28.8**	**46.3**	**22.3**	**27.8**	**45.2**	**21.9**	**26.7**	**42.9**	**21.7**	**25.5**
Oromo	1,057	3,102	4,159	572	2,155	2,727	414	1,850	2,264	306	1,549	1,855
	23.3	**28.7**	**27.1**	**24.6**	**27.6**	**26.9**	**24.4**	**27.7**	**27.0**	**25.0**	**27.9**	**27.4**
Tigraway	351	1,132	1,483	214	845	1,059	165	721	886	124	612	736
	7.7	**10.5**	**9.7**	**9.2**	**10.8**	**10.4**	**9.7**	**10.8**	**10.6**	**10.1**	**11.0**	**10.9**
Guragie	479	383	862	191	236	427	133	214	347	96	173	269
	10.5	**3.5**	**5.6**	**8.2**	**3.0**	**4.2**	**7.8**	**3.2**	**4.1**	**7.8**	**3.1**	**4.0**
Somalie	160	625	785	93	454	547	81	406	487	72	364	436
	3.5	**5.8**	**5.1**	**4.0**	**5.8**	**5.4**	**4.8**	**6.1**	**5.8**	**5.9**	**6.5**	**6.4**
Affar****	12	573	585	8	445	453	8	379	387	5	301	306
	0.3	**5.3**	**3.8**	**0.3**	**5.7**	**4.5**	**0.5**	**5.7**	**4.6**	**0.4**	**5.4**	**4.5**
Others	330	2,730	3,060	169	1,943	2,112	130	1,643	1,773	96	1,355	1,451
	7.3	**25.2**	**19.9**	**7.3**	**24.8**	**20.8**	**7.6**	**24.6**	**21.2**	**7.8**	**24.4**	**21.4**
Total	4,543	10,821	15,364	2,321	7,822	10,143	1,700	6,678	8,378	1,224	5,558	6,782
	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

*** In the multivariate models of urban areas this category is dropped due to small number of cases

**** In the multivariate models of urban areas this category is merged with the "Other" category

Table 2: Observed and estimated median age at each birth by place of residence, Ethiopia, 2000

	Median Age at			
	1st birth	2nd birth	3rd birth	4th birth
National				
- Estimated	20.14	22.03	24.59	27.01
- Observed	18.67	21.50	24.08	26.33
Urban				
- Estimated	22.37	23.24	25.74	27.82
- Observed	19.33	22.33	24.91	27.08
Rural				
- Estimated	19.59	21.77	24.38	26.86
- Observed	18.41	21.25	23.87	26.25

Table 3: Observed and estimated median durations in months between age 10 of respondent and first birth and between successive births by place of residence, Ethiopia,2000

	Median durations between			
	Age 10 & 1st birth	1st birth & 2nd birth	2nd birth & 3rd birth	3rd birth & 4th birth
National				
- Estimated	121.44	31.91	32.43	32.26
- Observed	104.00	29.00	29.00	29.00
Urban				
- Estimated	147.76	36.18	36.89	35.87
- Observed	112.00	31.00	31.00	31.00
Rural				
- Estimated	114.83	31.07	31.74	31.74
- Observed	101.00	28.00	29.00	29.00

Table 4: Time ratios of having first births by various covariates and urban-rural, Ethiopia, 2000

	Time Ratios			
	Urban		Rural	
	Model 1	Model 2	Model 1	Model 2
Age Cohort				
35 Years & above[R]	1.00	1.00	1.00	1.00
25- 34 years	1.02 (0.02)	1.01 (0.02)	0.98 (0.01)**	0.98 (0.01)**
15-24 years	0.98 (0.02)	0.97 (0.02)	0.99 (0.01)	0.99 (0.01)
Type of Union				
Monogamous [R]	1.00	1.00	1.00	1.00
Polygynous	1.00 (0.04)	0.99 (0.04)	1.03 (0.01)**	1.02 (0.01)**
Formerly married	1.05 (0.02)**	1.05 (0.02)**	1.11 (0.01)***	1.10 (0.01)***
Never Married	3.34 (0.10)***	3.38 (0.11)***	3.50 (0.13)***	3.53 (0.13)***
Age @ first Marriage				
16 years & under [R]	1.00	1.00	1.00	1.00
17 years and above	1.61 (0.03)***	1.62 (0.03)***	1.49 (0.01)***	1.51 (0.01)***
CP initiated before 1st child				
No[R]	1.00	1.00	1.00	1.00
Yes	1.29 (0.03)***	1.30 (0.03)***	1.16 (0.04)***	1.15 (0.04)***
Education				
No education		1.00		1.00
Primary		0.99 (0.02)		0.98 (0.01)**
Secondary & higher		0.96 (0.02)**		0.99 (0.01)**
Relgion				
Orthodox Christian[R]		1.00		1.00
Protestant		1.03 (0.03)		0.98 (0.01)
Muslim		1.08 (0.03)**		1.02 (0.01)*
Traditional & Others		-		1.05 (0.03)**

Cont'd Table 4 Time Ratios

	Urban		Rural	
	Model 1	Model 2	Model 1	Model 2
Ethnicity				
Amhara[R]		1.00		1.00
Oromo		0.96 (0.02)		0.96 (0.01)**
Tigrawi		1.04 (0.03)		1.02 (0.02)*
Guragie		0.95 (0.03)		1.05 (0.03)**
Somalie		1.00 (0.05)		0.97 (0.02)*
Affar		-		1.15 (0.02)***
Others		0.96 (0.03)		1.00 (0.01)
SIGMA				
THETA				
Sample size	4543	4543	10820	10820
Number of failures	2312	2312	7818	7818
Negative log likelihood	2036.32	2012.07	4145.89	4083.59
Likelihood ratio Chi-square	2547.77	2568.61	4434.59	4560.25
DF	7	16	7	18
Prob . Chi sq	0.000	0.000	0.000	0.000
Theta Chi-sq				
Prob				

Notes: R = Reference Category; Standard errors in brackets; Significance levels ***= 0.00; **=0.05; *=0.10

Table 5: Time ratios of having second births by various covariates and urban-rural, Ethiopia, 2000

	Time Ratios			
	Urban		Rural	
	Model 1	Model 2	Model 1	Model 2
Age Cohort				
35 years and above [R]	1.00	1.00	1.00	1.00
25 – 34 years	1.17 (0.04)***	1.20 (0.05)***	0.97 (0.014)*	0.98 (0.01)*
15 - 24 years	1.29 (0.08)***	1.35 (0.08)***	1.01 (0.02)*	1.01 (0.02)
Type of Union				
Monogamous [R]	1.00	1.00	1.00	1.00
Polygynous	1.17 (0.10)*	1.24 (0.10)**	1.03(0.02)*	1.07 (0.02)***
Formerly married	1.32 (0.05)***	1.30 (0.05)***	1.15 (0.02)***	1.14 (0.02)***
Never Married	3.16 (0.44)***	2.92 (0.42)***	1.60 (0.28)**	1.53 (0.27)**
CP use before 2nd child				
No[R]	1.00	1.00	1.00	1.00
Yes	1.45 (0.07)***	1.37 (0.06)***	1.39 (0.06)***	1.33 (0.06)***
Age @ first Marriage				
16 years & under [R]	1.00	1.00	1.00	1.00
17 years and over	1.04 (0.04)	1.05 (0.05)	0.95 (0.01)**	1.00 (0.01)
Age @ first birth				
18 years & under [R]	1.00	1.00	1.00	1.00
19 years and over	1.03 (0.05)	1.04 (0.04)	1.03 (0.01)**	1.02 (0.02)**
Survival stat. of 1st child				
1= alive [R]	1.00	1.00	1.00	1.00
2= dead	0.87 (0.04)**	0.89 (0.04)**	0.78 (0.01)***	0.78 (0.01)***
Education				
No education		1.00	1.00	1.00
Primary		0.95 (0.04)		1.04 (0.02)**
Secondary & higher		1.04 (0.04)		1.00 (0.02)

Cont'd Table 5

	Urban		Time Ratios	
	Model 1	Model 2	Model 1	Model 2
Relgion				
Orthodox Christian[R]		1.00		1.00
Protestant		0.97 (0.07)		1. 08 (0.03)**
Muslim		0.81 (0.04)***		0.95 (0.02)**
Traditional & others		-		1.07 (0.03)**
Ethnicity				
Amhara[R]		1.00		1.00
Oromo		0.90 (0.04)**		0.83 (0.02)***
Tigrawi		0.95 (0.06)		0.97 (0.02)
Guragie		0.96 (0.07)		0.86 (0.03)***
Somalie		0.69 (0.07)***		0.72 (0.02)***
Affar		-		0.93 (0.03)**
Others		0.81 (0.06)**		0.87 (0.02)***
SIGMA				
THETA=0				
Sample size	2321	2321	7822	7822
Number of failures	1681	1675	6627	6627
Negative log likelihood	2371.65	2330.17	5871.48	5740.29
Likelihood ratio Chi-square	222.21	286.76	448.82	711.21
DF	9	18	9	20
Prob > chi sq	0.000	0.000	0.000	0.000
THETA=0 chi sq				

Notes: R = Reference Category; Standard errors in brackets; Significance levels ***= 0.00; **=0.05; *=0.10

Table 6:Time ratios of having third births by various covariates and urban-rural, Ethiopia,20000

	Time Ratios			
	Urban		Rural	
	Model 1	Model 2	Model 1	Model 2
Age Cohort				
Above 35 years[R]	1.00	1.00	1.00	1.00
25-34 years	1.19 (0.06)***	1.25 (0.06)***	0.99 (0.01)	0.99 (0.01)
15-24 years	1.59 (0.19)**	1.77 (0.20)***	1.06 (0.03)**	1.06 (0.02) **
Type of Union				
Monogamous Marriage[R]	1.00	1.00	1.00	1.00
Polygynous Marriage	1.07 (0.11)	1.22 (0.12)*	1.04 (0.02)*	1.08 (0.02)***
Formerly married	1.41 (0.07)***	1.39 (0.07)***	1.12 (0.02)***	1.11 (0.02)***
Age @ first Marriage				
16 years & under [R]	1.00	1.00	1.00	1.00
17 years and over	1.02 (0.06)	1.06 (0.06)	0.98 (0.01)	1.02 (0.02)
Age @ first birth				
18 years & under [R]	1.00	1.00	1.00	1.00
19 years and over	1.08 (0.06)	1.09 (0.06)	0.99 (0.01)	0.98 (0.02)
Survival stat of prev. children				
both alive [R]	1.00	1.00	1.00	1.00
1 alive 1 dead	0.81 (0.04)***	0.82 (0.04)**	0.91 (0.01)***	0.91 (0.01)***
all dead	0.81 (0.06)**	0.84 (0.08)*	0.77 (0.02)***	0.77 (0.02)***
Education				
No education		1.00		1.00
Primary		1.00 (0.06)		1.02 (0.02)
Secondary & higher		1.02 (0.05)		0.99 (0.02)

Cont'd Table 6	Time Ratios			
	Urban		Rural	
	Model 1	Model 2	Model 1	Model 2
Relgion				
Orthodox Christian[R]		1.00		1.00
Protestant		0.86 (0.08)*		1.01 (0.02)
Muslim		0.80 (0.05)***		0.93 (0.02) ***
Traditional & others		-		1.07 (0.06)*
Ethnicity				
Amhara[R]		1.00		1.00
Oromo		0.87 (0.05)**		0.88 (0.02)***
Tigrawi		0.86 (0.06)*		0.98 (0.03)
Guragie		0.74 (0.06)**		0.91 (0.03)**
Somalie		0.60 (0.07)***		0.74 (0.02)***
Affar		-		0.94 (0.03)*
Others		0.84 (0.08)**		0.89 (0.02)***
Sample size	1684	1684	6603	6603
Number of failures	1204	1204	5491	5491
Negative log likelihood	1811.36	1765.51	5130.94	5044.97
Likelihood ratio Chi-square	82.05	163.00	164.81	336.74
DF	8	17	8	19
Prob > Chi-sq	0.000	0.000	0.000	0.000
SIGMA				
THETA				
THETA Chi-sq				
Prob > Chi-sq				

Notes: R = Reference Category; Standard errors in brackets; Significance levels ***= 0.00; **=0.05; *=0.10

Table 7: Time ratios of having fourth births by various covariates and urban-rural, Ethiopia, 2000

	Time Ratios			
	Urban		Rural	
	Model 1	Model 2	Model 1	Model 2
Age Cohort				
Above 35 years[R]	1.00	1.00	1.00	1.00
25 - 34 years	1.28 (0.07)***	1.37 (0.07)***	1.04 (0.02)**	1.05 (0.02)**
15 – 24 years	1.11 (0.22)	1.28 (0.24)	1.15 (0.05)**	1.17 (0.06)**
Type of Marital Union				
Monogamous Marriage[R]	1.00	1.00	1.00	1.00
Polygynous Marriage	1.02 (0.11)	1.10 (0.12)	1.00 (0.01)	1.04 (0.02)*
Formerly married	1.27 (0.07)***	1.27 (0.07)***	1.12 (0.03)***	1.12 (0.03)***
Age @ first Marriage				
16 years & under [R]	1.00	1.00	1.00	1.00
17 years and over	1.04 (0.07)	1.08 (0.07)	0.98 (0.02)	1.02 (0.02)
Age @ first birth				
18 years & under [R]	1.00	1.00	1.00	1.00
19 years and over	0.99 (0.06)	1.02 (0.06)	1.00 (0.02)	1.01 (0.02)
Surv. Sta. of prev. children				
all alive	1.00	1.00	1.00	1.00
2 alive 1dead	0.84 (0.05)**	0.84 (0.05)**	0.94 (0.02)***	0.93 (0.02)***
1 alive 2 dead	0.84 (0.07)**	0.85 (0.07)*	0.87 (0.02)***	0.87 (0.02)***
all dead	0.62 (0.10)**	0.66 (0.11)**	0.73 (0.02)***	0.74 (0.03)***
Education				
No education		1.00		1.00
Primary		0.99 (0.06)		1.06 (0.02)**
Secondary & higher		1.04 (0.06)		0.95 (0.02)**

Cont'd Table 7 Time Ratios

	Urban		Rural	
	Model 1	Model 2	Model 1	Model 2
Relgion				
Orthodox Christian[R]		1.00		1.00
Protestant		1.27 (0.13)**		1.04 (0.03)
Muslim		0.85 (0.06)**		0.94 (0.02)**
Traditional & others		-		1.07 (0.04)*
Ethnicity				
Amhara[R]		1.00		1.00
Oromo		0.88 (0.05)*		0.85 (0.02)***
Tigrawi		1.06 (0. 09)		1.01 (0.03)
Guragie		0.88 (0.08)		1.00 (0.05)
Somalie		0.63 (0.08)***		0.76 (0.02)***
Affar		-		0.89 (0.04)**
Others		0.68 (0.07)***		0.93 (0.03)**
Sample size	1224	1224	5491	5491
Number of failures	875	873	4526	4526
Negative log likelihood	1313.02	1282.82	4275.73	4187.42
Likelihood ratio Chi-square	45.66	101.98	134.64	311.27
DF	9	18	9	20
Prob > ch sq	0.000	0.000	0.000	0.000
SIGMA				
THETA				
THETA chi-sq				
Prob > ch sq				

Notes: R = Reference Category; Standard errors in brackets; Significance levels ***= 0.00; **=0.05; *=0.10

Appendix 1: Bivariate relationship between the timing of first, second, third and fourth births and selected covariates, Ethiopia

	Time Ratios			
	1st birth	2nd birth	3rd birth	4th birth
Age Cohort				
35 years and above R	1.00	1.00	1.00	1.00
25-34 years	1.10 (0.01)***	1.03 (0.015)**	1.01 (0.02)	1.06 (0.016)***
15-24 years	1.33 (0.01)***	1.19 (0.022)***	1.11 (0.03)***	1.14 (0.06)**
Type of Union				
Monogamous Marriage	1.00	1.00	1.00	1.00
Polygynous Marriage	1.02 (0.01)	1.00 (0.019)	1.00 (0.02)	0.98 (0.02)
Formerly married	1.06 (0.01)***	1.21 (0.021)***	1.20 (0.02)***	1.14 (0.02)***
Never Married	2.97 (0.06)***	2.85 (0.27)***	2.26 (0.37)***	4.40 (1.35)***
CP initiated before 1st/2nd child				
No R	1.00	1.00	_	_
Yes	1.48 (0.03)***	1.58 (0.04)***	_	_
Age @ first marriage				
16 years & under R	1.00	1.00	1.00	1.00
17 years and over	1.54 (0.01)***	1.02 (0.014)*	1.00 (0.02)	1.00 (0.02)
Never married	3.18 (0.06)***	2.78 (0.26)***	2.21 (0.36)***	4.34 (1.34)***
Age @ first birth				
16 years & under R	_	1.00	1.00	1.00
17 years and over	_	1.03 (0.013)**	0.99 (0.01)	0.99 (0.02)
Survival stat. of 1st child			_	_
alive R	_	1.00	_	_
dead	_	0.77 (0.01)***	_	_
Surv. stat. of prv. 2 Child.				
both alive R	_	_	1.00	_
1 alive 1 dead	_	_	0.88 (0.014)***	_
both dead	_	_	0.75 (0.018)***	_

Appendix 1: Cont'd

	Time Ratios			
	1st birth	2nd birth	3rd birth	4th birth
Surv. Stat. of prev. 3 child.				
all alive R	_	_	_	1.00
2 alive 1dead	_	_	_	0.91 (0.02)***
1 alive 2 dead	_	_	_	0.85 (0.02)***
all dead	_	_	_	0.70 (0.03)***
Education				
No education	1.00	1.00	1.00	1.00
Primary	1.04 (0.01)***	1.02 (0.02)	1.02 (0.02)	1.06 (0.02)**
Secondary & higher	1.11 (0.03)***	1.06 (0.02)**	1.04 (0.02)*	1.00 (0.02)
Relgion				
Orthodox Christian R	1.00	1.00	1.00	1.00
Protestant	1.05 (0.01)***	0.94 (0.019)**	0.90 (0.02)***	0.97 (0.02)
Muslim	0.99 (0.01)	0.80 (0.012)***	0.81 (0.01)***	0.82 (0.01)***
Traditional & others	0.99 (0.02)	0.91 (0.03)**	0.93 (0.03)*	0.96 (0.04)
Ethnicity				
Amhara R	1.00	1.00	1.00	1.00
Oromo	1.01 (0.01)	0.79 (0.014)***	0.82 (0.02)***	0.83 (0.02)***
Tigrawi	0.95 (0.01)**	0.93 (0.021)**	0.94 (0.02)**	1.01 (0.03)
Guragie	1.24 (0.03)***	0.88 (0.029)***	0.83 (0.03)***	0.97 (0.039)
Somalie	1.04 (0.03)**	0.65 (0.02)***	0.66 (0.02)***	0.71 (0.02)***
Affar	1.00 (0.02)	0.81 (0.03)***	0.81 (0.03)***	0.80 (0.03)***
Others	1.01 (0.01)	0.85 (0.02)***	0.85 (0.02)***	0.90 (0.02)***
Type of place of residence				
Urban R	1.00	1.00	1.00	1.00
Rural	0.81 (0.01)***	0.81 (0.012)***	0.80 (0.01)***	0.82 (0.02)***

Notes: R = Reference Category; Standard errors in brackets; Significance levels ***= 0.00; **=0.05; *=0.10