Migration and Fertility in Coastal Ghana:
An Event History Analysis

Michael J. White

Salut Muhidin

Catherine N. Stiff

Brown University, USA

Eva Tagoe

University of Science and Technology, Ghana

Rodney Knight

Principia International, USA

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Abstract. In this paper we undertake an event history analysis of fertility in Ghana. We exploit detailed life history calendar data to conduct a more refined analysis of the relationship between personal traits, urban residence and fertility. Although urbanization is associated with lower fertility in developing country settings, most studies have been hampered by lack of information about the timing of residence in relationship to childbearing. The effect of urbanization itself is strong, evident, and complex, even after controlling for the effects of age, cohort and education. Continuously urban residents exhibit fertility rates that are about 15% lower than rural women at every parity. Rural-urban movers, by contrast, exhibit a very parity-specific pattern, with slower progression to second birth. Our results suggest that the urbanization effect on reducing fertility occurs more in later generations than within the rural-urban migrant generation itself.

I. Introduction

Although urbanization is associated with lower current fertility in developing country settings, the details of how urban residence and migration might actually alter fertility behavior are not well understood. Thus, while observers can generally remark on the intertwining of urbanization and the demographic transition, knowledge of the timing of changes in individual behavior, and the way in which population redistribution might determine vital outcomes is sorely lacking. This lack of knowledge is particularly troubling when deep concerns persist about the relationship between demographic processes and economic development. Moreover, although population growth and urbanization are often deemed to be threats to environmental quality, scholarship on the relationship between urbanization and the contemporary shift in rates of increase also remains quite limited.

In this paper we address this deficiency by presenting and analyzing data on the timing of fertility change in Ghana. Concerns about demographic dynamics, economic development, and environmental quality all intersect in this analysis. We address the demographer's conventional concern about the timing and pace of fertility change. Our statistical work attempts to identify the relative influence of various personal traits on the onset and pace of childbearing.

This study also touches on environmental concerns in the region. High rates of population growth are almost always seen as deleterious for the environment. Furthermore, urbanization is often seen as problematic. Such environmental concerns are heightened in growing and urbanizing tropical coastal zones, which harbor productive and diverse natural ecosystems. All of this is brought to a more acute level in sub-

Saharan Africa, where population growth rates remain very high by world standards, and economic development lags. Our study of coastal Ghana is selected to give insight into these issues.

The state of knowledge regarding the migration-urbanization-fertility relationship is still limited. There have been several attempts to analyze the relationship, of course. Extensive work in Thailand, for instance, has suggested that migration to urban areas bring adaptation to new norms that accord with reduced fertility (Goldstein and Goldstein 1983). Migration seems also to be associated with delayed onset of childbearing and lower overall birthrates in China and Vietnam (Goldstein, White, and Goldstein, 1997; White, Djamba, and Anh, 2001). The case for sub-Saharan Africa and the associated evidence are less clear, however (Oucho and Gould 1993). Some analysis with the Demographic and Health Survey (DHS) data for multiple African countries suggest that rural-urban migration is linked to fertility decline (Brockerhoff and Yang 1994; Brockerhoff 1998). Others, however, argue that there is no association between migration and fertility, or that fertility may actually increase with urbanward movement (Hollos and Larsen 1992; Lee 1992; Diop 1985; Cleveland 1991). Almost all of these studies – whether for Africa or other world regions – have been hampered by limited information on the timing of both geographic mobility and fertility. Generally, expectations would be that urbanization would reduce fertility, as urban residence would likely increase the costs of raising children. Urban housing is more expensive, and children are probably less valuable in household production in urban (vs. rural) areas. Furthermore, urbanization (or urbanism) may be associated with ideational change, that is, beliefs and attitudes surrounding large families and high parities.

This paper analyzes newly collected data from the region. We exploit the innovation of a life history calendar that includes both annual residence and birth information. This enables our event-history analysis to more accurately assess the relationship between urban living, migration, and fertility, while controlling for conventional personal characteristics. In this way we can get some purchase on the effect of urban residence overall, and more specifically, the effect of rural-urban migration on fertility over the childbearing sequence.

We examine several hypotheses about the determinants of fertility change in Ghana. In the literature on the migration-urbanization-fertility relationship three mechanisms are generally cited: selection, disruption, and adaptation. Selection operates when movers have a different set of personal traits (or *a priori* behavioral intentions) that would be associated with lower fertility. Disruption operates under spousal separation; it is most relevant for cyclical migration or in circumstances when one partner moves and establishes work and residence in the new location, followed by the other partner later. Adaptation (sometimes called socialization) operates when long-term experience, within or across generations, operates to socialize individuals. It is the final mechanism that is of most interest to us in this paper, although our results have some value for the range of mechanisms taken together.

The literature on migrant adaptation and fertility has had very little discussion of parity specific effects. This may be due to the paucity of data on the migration experience and its timing. We might think, however, that the effect of these processes, especially socialization, would operate in a parity specific way. In this paper we control for parity, along with other traits, in our analysis of fertility behavior.

We have several key expectations or hypotheses offered for the effects of migration and urbanization, and also for some other traits. Most generally we expect the exposure to urban residence to decrease rates of childbearing overall. That is, women who have resided continuously in urban areas from their childhood to the present will, net of other characteristics, have lower fertility rates. Moreover, drawing on the literature on selection, we would expect rural-urban migrants to also exhibit lower fertility; that is net of other traits, longer duration urban residence should lower the rate of childbearing.

Finally, we examine parity-specific effects of these migration and urbanization mechanisms. Since urbanization is generally associated with the demographic transition, we would expect a shift in the childbearing profile with age. Urbanization (urban residence covariates in our model) should be associated with a delayed onset of childbearing and a steeper reduction in fertility at older ages and higher parities. Thus, we would expect to see an effect of urbanization in the first birth and in higher order (women already at 3+ parity) births. Effects of urban residence might be modest for the second and third birth.

These expectations are advanced net of other covariates we can control in our model. In keeping with the well established literature on fertility, we expect standard age effects. We also effect that education to be associated with declines in fertility. We also test for cohort effects; our expectation here is that more recent cohorts will show lower rates of childbearing. .To be more explicit about our expectations, we know that urban populations differ in many compositional ways (among them age and education) from rural populations; our intent here is to determine the effect of urban residence (by parity and migration status), even after controlling for these other effects. At the same time, we know that secular changes in education (and presumably urbanization) operate in most societies to hasten fertility transition. With our data, we can test whether such cohort effects persist after adjusting for residence and education.

II. Data and Methods

Study Site: Ghana's Central Region

We analyzed data from the 2002 Population & Environment Survey of the Central Region in Ghana, one of 10 administrative regions (i.e., provinces) in Ghana. The 2000 Ghanaian census recorded a national population at 18.9 million people, a 54 percent increase from the 1984 (the year of the previous census) population of 12.3 million, and representing an intercensal growth rate of 2.7 percent (GSS 2002:1). The population of Central Region is about 1.6 million. We chose the Central Region due to the availability of coastal lagoons in this region that could provide the setting for a parallel study of water quality. Our survey is representative of the six coastal districts in the Central Region: Komenda-Edina-Eguafo-Abirem (KEEA), Cape Coast, Abura-Asebu-Kwamankese, Mfantsiman, Gomoa, and Awutu-Efutu-Senya. This area of Ghana is primarily inhabited by the Fante ethnic group (an Akan sub-group linguistically related to the Ashanti), as well as other smaller groups (e.g., Ewe, Ga-Dangme, etc.). Nationally, the Fante comprise about 10 percent (or about 1.7 million people) of Ghana's total population. While Ghana's major sources of foreign exchange are gold, timber and cocoa, economic activities in the study area include fishing, small-scale farming, salt production, and some tourism activities (concentrated around the former slave trading castles dotting the Central Region coastline which now operate as museums).

The Population & Environment Survey is a representative household-based survey of these six coastal districts. The intent of the survey was to study migration, fertility, child health knowledge and behaviors, and environmental attitudes. The six districts in the sample represent approximately four percent of Ghana's total population (GSS 2002:1, 17). The sample size of the individual portion of the survey was 2506; 1093 men aged 15 and above, or 94 percent of identified eligible men, were interviewed; 1413 women aged 15 and above, or 93 percent of identified eligible women, were interviewed in our survey. The sex ratio of our adult sample, or the respondents to our individual questionnaire, was 0.77, which reflects high out-migration of men in this region of Ghana. Indeed, while the 2000 census all-ages sex ratio for Ghana's Central Region is 0.91 (and the lowest in Ghana), the sex ratio for the adult population (i.e., age 15 and above) is still lower: 0.84. This compares more favorably with our sex ratio of 0.77.

Twenty-two percent of the respondents to our survey reside in rural areas, 39 percent in semi-urban areas, and 39 percent in urban areas. Thus, more than three-quarters (78 percent) of our respondents – and the residents of these six districts in our study area – reside in urban or semi-urban areas, demonstrating the relatively urbanized nature of this area of Ghana. For comparison, the 2000 census classified 37.5 percent of Central Region's population as urban (GSS 2002:17). (Recall that our study area comprises only the six coastal districts of Central Region, and not the entire region.) Central Region is the third most urbanized region in Ghana, following neighboring

Greater Accra (87.7 percent urban) and Ashanti regions (51.3 percent) (GSS 2002:17). (Nationally, about 44 percent of Ghana's population is urban, an increase from the 1984 level of 32 percent (GSS 2002:2). Ghana is still predominantly rural, but is urbanizing rapidly.)

Survey Instruments, Sampling and Fieldwork

The 2002 Ghana P&E survey included four components: a community questionnaire, a household questionnaire, a men's questionnaire, and a women's questionnaire. The household questionnaire contained questions on current household composition, basic characteristics of household members and economic characteristics of the household. The women's questionnaire had modules on the respondents' socio-demographic background, birth history, health knowledge, child health (of living children under six years of age), fertility preferences and family planning, and environmental attitudes and awareness. The men's questionnaire was a reduced version of the women's questionnaire, excluding the modules on birth history and child health. While the survey instruments were similar to the Demographic and Health Survey (DHS) in form and content, the instruments incorporated unique sections on knowledge of etiology of specific childhood illnesses, household hygiene practices, and environmental attitudes and awareness.

Both the women and men's questionnaires included a life history calendar (LHC). Data for this paper are largely drawn from this component of the survey. The calendar includes domains on region of residence, urban or rural residence, education, occupation, marital status, and births and deaths of children by yearly intervals. Information was collected by year, rather than month, because the LHC covers an individual's entire lifetime and it was not expected that older individuals will remember information on a monthly basis for events that occurred early in their lifetimes. All men and women age 15 and above completed the LHC. While event history calendars have been used in other demographic surveys, this is, to the best of our knowledge, one of the first such applications in a low-income, sub-Saharan African setting.

We followed a two-stage stratified sampling design. Our primary sampling units were enumeration areas (EAs) drawn from the 2000 census. We sampled six EAs from each of three strata (urban, semi-urban, rural) from each of the six coastal districts, for a total of 54 PSUs. In the analysis we use weights to compensate for the sample size in each strata not being proportional to the stratum size. We chose this design in order to evenly spread the sample across the strata, ensuring that there is sufficient sample size in each stratum type (urban, semi-urban, and rural) to be able to perform the analysis by stratum type. Within each stratum we selected three EAs probability proportional to size (PPS) of the EA. The Ghana Statistical Service (GSS) provided the list of EAs with population information required for this process.

After selecting the EAs, survey listing teams listed all of the households in the selected EAs. In addition to providing a list of households for selecting the sample, the household listing provided population information needed for the weights. Based on the lists, we randomly selected 24 households from each EA. Survey teams then interviewed all women and men age 15 and above in each selected household.

We calculated 24 households per EA would give us the minimum cost to provide a given level of precision. Listing costs increase as more EAs are added to the sample.

Interview costs increase as the design effect increases, because an increase in the design effect requires more interviews to maintain a given precision. The design effect can be reduced by decreasing the number of households selected per EA, but that will result in more EAs being required, which will increase the cost of the household listing process. The optimal number of households per EA was found by balancing the costs of listing and interviewing.

A high level of quality of the fieldwork was maintained through careful training and supervision. Supervisors and interviewers were trained extensively on administering the questionnaire and fieldwork procedures. Prior to the start of the fieldwork, interviewers pre-tested the questionnaire in a nearby community, and the questionnaire was revised as a result. During the fieldwork, the supervisors carefully checked the work of the interviewers. Co-author Stiff was present in the field during most of the fieldwork in order to maintain a high level of quality. After the completion of the fieldwork, data was entered into a computer database, checks were done for the consistency, and errors were corrected.

In order to present results that are representative of the survey population in the six districts, we apply weights to our descriptive statistics (although we present unweighted regression results). The weights adjust for the equal sizes of the sample in the strata, errors in the original EA population values used to select the EAs, and non-response. The strata adjustment ensures results properly represent the population in each stratum. The adjustment for the EA population corrects the results to represent the actual population in the EAs based on the household listing. The non-response adjustment corrects for those households and individuals who did not complete the questionnaires in an EA.

Measures

We perform analysis on five dependent variables related to fertility. We examine fertility over time in an event history analysis with a variable that measures whether or not a woman gives birth in a given year. Values of this birth variable are set to 1 in years when the woman gives birth and 0 otherwise. For descriptive purposes we also examine, and present selected results for: 1) the total fertility rate (TFR), 2) age specific fertility rates (ASFRs), 3) mean children ever born (CEB), and 4) fertility in the past five years. TFR and ASFR in this analysis are based on the five years prior to the survey (1997-2001). Fertility in the past five years measures the average number of births women have had in the five years prior to the survey. In descriptive analysis, we use the mean value of CEB for all women. CEB in this analysis does not measure lifetime fertility like TFR because CEB is based on the number of births women have had prior to the survey and most women in the survey have not yet completed their reproductive years.

Parity is a measure of fertility that appears as an independent variable in our analysis. Parity measures the number of children women have had up to a specific time. In the event history analysis parity functions as a time-varying covariate; parity for a woman increases by one if she has had a birth in the prior year. Parity has a direct relationship to CEB. At the time of the survey, parity for a woman equals CEB for the woman.

Table 1 presents characteristics of three of these fertility variables (CEB, fertility in the past five years, and parity) and other variables that appear in the analysis. This table includes information on all women age 15 and above, women of reproductive age (aged 15 to 49), and women over 50 years old. Commonly, fertility analyses such as DHS-based studies focus on women of reproductive age, primarily because many surveys are limited to those years. As mentioned earlier, the 2002 P&E survey completely interviewed women aged 15 and above. The inclusion of a full life history calendar in this survey means that a woman older than reproductive age will have recorded information in the calendar on her fertility and life history during her reproductive years. Given this information, we can perform fertility analyses both on women currently in reproductive years and those older than reproductive age, as well as fertility analysis on women of all ages over 15 years.

The fertility variables presented in Table 1 show clear differences between women of reproductive years and those over age 50. Women over age 50 have completed their reproductive years and as a result have higher values for CEB. Among women over 50, CEB is 7.0 while CEB for women of reproductive years is 2.4, reflecting both relative completion of reproductive exposure and temporal declines in childbearing rates. The TFR for women in the Central Region was 4.4 in 2002. The TFR is less than CEB for women over 50 because TFR measures current period fertility as hypothetical lifetime fertility based on current age specific fertility rates whereas CEB for women over age 50 measures fertility for women who have completed fertility in the past when fertility rates were higher. The distribution of the women at different parities fits the pattern of high fertility for women over age 50 and lower fertility for those of reproductive age. Over 90 percent of women over fifty are in parity three or higher, which makes sense given a value of 7.0 for CEB. A much lower percentage (about 40 percent) of reproductive age women had three or more children as of the time of the survey.

The focus of our analysis is to understand the relationship between migration and fertility. We measure migration and residence in a variety of ways, mostly taken from the life history calendar. Key measures of migration in the event history analysis relate to urban residence. Recent place of residence is measured by urban residence in the past year, t-1 (rural = 0, urban = 1). Place of residence at a young age is measured by urban residence at age 15. Rural-to-urban and urban-to-rural migration can be found by creating an interaction term between these two measures of residence. If a woman lived in a rural area at age 15 and was living in an urban area in the last year, she is a rural-to urban-migrant. Likewise, a woman is an urban-to-rural migrant if she lived in an urban area at age 15 and lived in a rural area last year. We have tried other measures of migration in the event history analysis, but found these measures highly correlated with our urban residence interaction term. As a result, these measures did not give us more useful insights than the interaction term. Comparison of women of reproductive age with women over age 50 in Table 1 indicates that women of reproductive age have higher levels of urban residence, especially at age 15. About 66 percent of women aged 15-49 lived in urban areas at age 15 compared to 49 percent of women over age 50.

In addition to past urban residence, we measure place of residence at the time of the survey based on the Ghana Statistical Service (GSS) definitions for place of residence (urban, semi-urban, and rural). The GSS definitions can be used at the time of the survey because the place of residence of each sampled EA is known. Past residence must be self reported (in the LHC), because the respondents would not know the GSS classifications for the places where they lived in the past. However self reporting constrains the place of residence to either urban or rural in our event history analysis. Respondents also answered a question in the survey on the place of childhood residence, which we use as another measure of residence. Answers to this question can reliably measure place of residence, because the response categories for this question (city, town and village) are well understood.

The life history calendar allows us to construct more complex measures of migration, enabling us to examine migration patterns in more detail. In addition to information on rural or urban residence, the respondent provided a complete history of her region of residence by year. With this information, we determined the number of times individuals migrated between regions. Combining the urban-rural and regional residence histories, we found the ages at the first, second and third migration. Such a measure misses urban-to-urban and rural-to-rural migrations within a specific region. We created a measure for the lifetime urban-to-rural sequence from the urban-rural history. This variable has eight sequences that combine urban-rural residence at birth, age 15, and time of survey, as shown in Table 3. These sequences show different patterns of urban-rural residence, some of which involve migration. The only sequences that do not involve migration are those that are completely urban or completely rural. Any change from urban-to-rural or rural-to-urban implies that migration occurred.

We measured the duration of residence in the Central Region with the regional residence history. Results in Table 1 indicate that older women remained in the Central Region longer in their youth. Among women age 50 or older, 71 percent have remained in the Central Region for 16 or more years, compared to 47 percent of reproductive age women.

Several other independent variables appear in the event history analysis of births. We measure age directly as a time-varying covariate that increases for each year in the analysis. Because age can have non-linear effects, we add an age squared term to the analysis. Cohort effects are measured by dividing cohorts into three groups: a young cohort (born at or after 1970), a middle cohort (born between 1950 and 1969), and an older cohort (born before 1950). Education is measured by three groups: 1) none and Koranic, 2) primary and middle school (in Ghana, called Junior Secondary School, JSS), and 3) secondary school or higher. Women of reproductive age clearly have much higher levels of education than women over age 50. In Table 1, 72 percent of women of reproductive age have primary or more education, whereas only 24 percent of women over 50 have such education. This pattern reflects development of the educational system in Ghana. The national program of education, which was designed to provide an education for every child aged six and older, was officially implemented in 1961 (Owusu-Ansah 1995).

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Methods

We study the effect of migration on fertility in the Coastal Region of Ghana with a variety of methods. We first examine the effects of different covariates on fertility descriptively and graphically. In presenting graphs of TFRs and ASFRs for different types of residence we confirm that urban areas of the Coastal Region have lower recent fertility than rural areas. We show through graphs that higher levels of socioeconomic status (SES) and education correspond to lower levels of fertility. Complementing the graphical analysis, we descriptively present the effect of SES and education on three measures of fertility (TFR, CEB and fertility in past five years). In another descriptive analysis, we study migration patterns with various measures of migration.

These graphical and descriptive analyses present information suggestive of the effect of migration and other factors on fertility. We examine the effect of migration and other factors on fertility in more depth with an event history analysis. In this analysis of the timing of first and subsequent births, we use a discrete time logistic model, an extension of logistic regression. This estimation procedure divides time to first (or subsequent) birth into discrete intervals and estimates the probability of observing the event (birth) within each interval (White et al. 1995). Time-varying covariates – such as place of residence – are easily accommodated by this model; for each discrete interval, a new value of the covariate can be included (e.g., time-varying characteristics can change from year to year). The model estimates the probability of an event occurring, conditional on no event having yet occurred, in each subsequent year. We start the analysis at age 12 and continue up to the current age of the women.

Our event history analysis starts with a simple bivariate model and moves to a more complete multivariate model. The bivariate analysis examines the effect of recent urban residence (e.g., one year ago) on fertility. We then perform a simple multivariate analysis focused solely on the effect of migration and residence on fertility. The model for this analysis is:

$$\text{logit}\ (p_{it}) = \alpha + \beta_1 U_{i15} + \beta_2 U_{i(t-1)} + \beta_3 U_{i15} U_{i(t-1)} + \varepsilon_i \quad (1)$$

where p_{it} is the probability of a birth for women *i* at time *t*; U_{i15} is urban residence at age 15; $U_{i(t-1)}$ is urban residence at time *t*-1 (the prior year); α is the constant; β_1 , β_2 , and β_3 are coefficients; and ε_i is the error term.

If both U_{i15} and $U_{i(t-1)}$ equal 1 the individual has remained in an urban area since age 15. The interaction term will equal one in this case and the overall effect will be the sum of all three coefficients. If U_{i15} and $U_{i(t-1)}$ equal 0 the individual is viewed as someone who has stayed in the rural area continuously. If U_{i15} equals 0 and $U_{i(t-1)}$ equals 1 the individual is a rural-to-urban migrant. Conversely, if U_{i15} equals 1 and $U_{i(t-1)}$ equals 0 the individual is an urban-to-rural migrant. Due to the simple form for migration this model will miss cyclical migration, but this model has been found to work well compared to more complex specifications.

After this simple bivariate analysis, we perform a more complete analysis that includes other traits of the woman. The more complete model is of the form:

$$\text{logit}\ (p_{it}) = \alpha + \beta_1 U_{i15} + \beta_2\ U_{i(t-1)} + \beta_3\ _{i15}\ U_{i(t-1)} + \boldsymbol{\beta_x X_i} + \boldsymbol{\beta_{xt} X_{i(t-1)}} + \varepsilon_i \qquad (2)$$

where: $\mathbf{X}_i$ is a matrix of covariates constant over time; $\mathbf{X}_{i(t-1)}$ is a matrix of time-varying covariates, and $\boldsymbol{\beta}_x$ and $\boldsymbol{\beta}_{xt}$ are the respective vectors of coefficients.

We run all of the event history models (bivariate and multivariate) for all parities and separately by parity (0, 1, 2, and 3 or more), because the number of prior births may strongly affect the time to the next birth.

Along with the coefficients of each model, we graphically present the odds ratios of having a birth by parity. The odds ratios for the bivariate model are relative to women who live in rural areas. Specifically, the odds ratio is the odds that a women living in an urban area in the past year will give birth relative to the odds of her giving birth if she had lived in a rural area. Odds ratios for the multivariate models are relative to women who have continuously lived in a rural area. The urban continuous graphs present the odds that a woman continuously living in an urban area will give birth relative to her giving birth if she had continuously lived in a rural area. Rural-urban movers' graphs represent the odds a woman who has moved from a rural to an urban area will give birth relative to if she had lived continuously in a rural area.

III. Findings

Rural and Urban Fertility Levels

Figure 1 shows the Total Fertility Rates (TFRs) of Central Region women by two measures of residence: residence during the current period (e.g., time of the survey) and residence during childhood (e.g., up to age 12). Note that *current residence*, the first trio of columns in Figure 1, is classified as urban, semi-urban, or rural, and indicates the community-level Enumeration Area (EA) classification. In other words, this measure of residence is the GSS (census) classification of the respondent's community. In contrast, *childhood residence*, the second trio of columns, is (akin to DHS wording) classified as city, town, or village, and is the respondent's own assessment of the level of urbanization of her childhood place of residence.

Figure 1 reveals substantial differences in fertility rates by type of residence. Women who live in urban communities have substantially lower fertility than women living in semi-urban or rural areas. Urban women have a TFR of 3.5 births relative to 5.2 among semi-urban and 4.5 among rural women. Additionally, women who grew up in the city have lower fertility (3.6) than those who grew up in towns (4.5) and or, in particular, those who grew up in rural areas (4.5).

------------ Figure 1 about here --------

Figure 2 shows Age Specific Fertility Rates (ASFRs) among Central Region women by current residence (i.e., EA classification). Women who live in urban areas demonstrate lower fertility rates in all ages. In contrast, women who live in rural areas both have higher ASFRs at nearly every age and tend to have children earlier than their counterparts (i.e. their fertility peaks at age 20-24, unlike urban residents).

------------ Figure 2 about here --------

Fertility Differentials by SES

We also examined fertility differentials by two socio-economic status variables: a household possession index and educational attainment. The possession index is a Likert index of 11 household possessions, and is thus an indicator of household (as opposed to individual) SES. Educational attainment is an individual-level indicator of SES. Table 2 presents TFRs by these two measures of SES. Women who have greater household SES (the possession index) and women with more education have lower fertility than their counterparts. This is true for both current fertility (e.g., TFR and 5-year fertility) and cumulative fertility (e.g., CEB). For those with a household SES of 4+ possessions, the TFR is 3.5 births. For women with secondary schooling or beyond, the TFR is 2.9.

------------ Table 2 about here --------

Migration Patterns

In our study, migration is measured by residential movement by yearly intervals and region (province) is utilized as the geographical unit of analysis. Thus, in our analysis, migration is an inter-region residential movement. A migrant is defined as a person who has a different region of residence compared to the previous year (i.e., *t-1*).

Under this definition of inter-regional yearly migration, and as shown in Table 3, we found that most women in our study – 58 percent – are non-migrants. The remaining women have moved across regions once (18 percent), twice (18 percent), three times (3 percent), or more (3 percent). Among the migrants, many of them have migrated one (18 percent) or two times. And, as we would expect, older women have migrated more than younger women.

Table 3 also shows that women of childbearing age (15-49) tend to migrate earlier than do older women (aged 50+). The mean age at first migration, for example, was 16 among reproductive age women, while it was 22 among older women. This age differential is also found for the second and third migration.

Finally, and in order to better visualize patterns of residence, we examine the residential sequences of the sample women at three different points in time: age 0 (the place of birth), age 15 (the onset of the reproductive years), and at current age (age at the time of the survey). Table 3 reveals these different residential sequences. Over three-quarters (78 percent) of the women in this study are either continuous urban (47 percent) or continuous rural (30 percent) residents, meaning they were living in an urban (or rural) area at birth, at age 15, and at the time of the survey. The remaining women include urban-rural movers (7 percent), rural-urban movers (8 percent), or other residence combinations (7 percent).

------------ *Table 3 about here* --------

Bivariate Models

Table 4 presents discrete time logit results predicting the probability of giving birth at all parities. Model 1.1 examines fertility as a function of living in an urban area the year prior to the survey, time *t-1*, which indicates conception time. Note that in this and subsequent multivariate models, we use life history calendar data for residence (in lieu of the "current residence" and "childhood residence" variables used in Figure 1). In the LHC, each respondent was asked whether her place of residence was rural or urban for each year of her life from birth to the time of the survey. Thus these LHC residence variables are dichotomous (as opposed to the variables used in Figure 1), but are time-varying by yearly intervals. The results in Model 1.1 indicate that living in an urban area at the time of conception (*t-1*) decreases the predicted probability of having a birth at time *t*. The effect is negative at every parity, but is stronger for parity 0 (first birth) and parity 2 (third birth). As shown in Figure 3, which graphically presents the odds ratios from Model 1.1, women who live in urban areas at time *t-1* will have between 15-25 percent lower fertility than those who live in rural areas.

Model 1.2 in Table 4 estimates the probability of birth as a function of different residential sequences. For all parities except parity 2 (third birth), the interaction between urban residence at age 15 (the onset of childbearing) and at time *t-1* (conception time) is significant. Figure 4 demonstrates that women who live continuously in urban areas (i.e., urban at age 15=1, urban at time *t-1*=1, and their interaction=1) have lower fertility than those who live continuously in rural areas. In contrast, women who have moved from rural to urban areas have a higher probability of giving birth in parity 0 and parity 3+ than their continuous rural counterparts. The odds ratios are 43 percent higher for parity 0 (first birth) and 8 percent higher for parity 3+ (fourth or higher birth) than the reference group, women who live continuously in rural areas. (Subsequent analysis for parity 0 shows that this higher rate is due to a favorable age composition; once full controls are introduced, rural-urban movers have lower first birth rates.) Yet for parity 1 (second birth) and parity 2 (third birth), the odds ratios for rural-urban movers are lower (36 and 8 percent, respectively).

Possible explanations for this parity-specific pattern are family building strategies or adjustment processes. The family building strategy explanation suggests that some women may have migrated from rural to urban areas to join (or seek) husbands, and thus first births are more likely to occur among them then among their rural counterparts. The adjustment explanation suggests that those rural-urban migrants who already have one or two children may choose to extend the interval to their second or third births, and thus delay the time to parity 1 and parity 2.

------------ Table 4 about here --------

------------ Figures 3 and 4 about here --------

Multivariate Event History Model

Table 5 presents the results from our multivariate analysis. These results indicate a positive relationship between age and the probability of having a birth across all parities. In contrast, however, a women's cohort has a negative effect, except in parity 0 (first birth). In general and as described earlier, women in the two younger cohorts are less likely to give birth than those in the oldest cohort (the reference group). This reflects Ghana's recent fertility decline. Additionally, educational attainment is associated with a decreased probability of birth. In general, more educated women are less likely to give birth than those without any schooling (the reference group).

Upon examining the urban residence variables in this model, we find the same pattern as in Model 1.2 in Table 4 and Figure 4. Table 5 reveals that across all parities except parity 2, the interaction between urban residence at age 15 and at time *t-1* is negative and significant. Odds ratios from this multivariate model are presented graphically in Figure 5. Unlike Figure 4, in this model, controls are added for other characteristics known to affect fertility (i.e., age, cohort, education) besides residence.

As we see in Figure 5 and net of the effects of age, cohort and education, women who were living continuously in an urban area (the first group of columns) have lower odds of giving birth than those who were living continuously in rural areas. This is strongly in keeping with the hypothesis of adaptation (socialization). It further reinforces the view that lower urban fertility is not merely due to compositional influences, such as age and education of the women.

Rural-urban movers (the second group of columns in Figure 5) also have lower odds of giving birth at every parity except parity 3+. While both movers and urban continuous residents exhibit lower fertility than continuous rural residents, rural-urban movers' overall odds ratio is higher than those of urban continuous residents. In Figure 5, our multivariate analysis, we see that the combined influence of women's age, cohort, education, residency, and parity have lead to different substantive conclusions (i.e. lower odds ratios) than the findings from bivariate analysis. Most notably, women who have moved from rural to urban areas proceed to a second child at much lower rates than women residing continuously in urban or rural areas. As with Table 4, explanations of family building strategies and the adjustment process are useful toward explaining our multivariate findings in Table 5.

------------ *Table 5 about here* --------

------------ *Figure 5 about here* --------

IV. Conclusions

We find strong evidence for the association of urbanization with lower fertility. More important, perhaps, our exploitation of an event history calendar gives us a much more refined view of the relationship between residence and childbearing. Our analysis also confirms and extends some of our knowledge about the other determinants of fertility in a developing sub-Saharan African setting.

Our results point to the clear impact of cohort on fertility. Even after controlling for other individual traits, we find that realized fertility declines markedly with successive cohorts. Moreover this cohort effect on fertility becomes more pronounced at higher parities, a clear indication of delaying and stopping behavior. We find the expected age profile of fertility, both in descriptive plots of age specific fertility rates and in multivariate models with a quadratic term. We also find appreciable effects of education, as expected, with more educated women, especially those with secondary education or more, exhibiting lower fertility at every parity. We know that younger cohorts are more likely to have urban experience, while education is also associated with urbanization. To be sure, urbanization is linked to declining fertility through these broad social changes.

The effect of urbanization itself is strong, evident, and complex. Prior to the introduction of controls for personal traits, our event history model points to a 20% lower odds of giving birth for an urban resident. Our more elaborate model allows for the effect of urban residence in each year (at risk of conception), and also controls for urban or rural residence at age 15. We also include an interaction term, thereby capturing the full range of residential patterns. We tested a wide array of specifications, and we only recapitulate the key findings here. First, net of other traits, continuously urban residents – urban natives – exhibit fertility odds that are about 15% lower than otherwise equivalent rural women. This "urban" effect differs modestly by parity with urban women's first births occurring with about 25% lower odds. We take this to be reflective of urban norms (delayed union), opportunity costs (education and employment), and family planning access.

Rural-urban movers exhibit a very parity-specific pattern. Again, in our models we have the advantage of tracking urban residence on an annual basis. Even after adjustment for age, cohort, and education, *overall* childbearing differs little among rural-urban movers than from the rural women they left behind. Rather, migrant women appear to delay the second child and bear their third or subsequent child at higher rates. More work needs to be done to uncover the behavioral processes associated with this parity-specific pattern.

All this suggests an important insight into the urbanization-fertility process. A strong fertility adaptation effect of migrants themselves is difficult to discern in these data. In this population, the urbanization effect on reducing fertility – net of some of the other social traits with which fertility is correlated – occurs more across generations than within.

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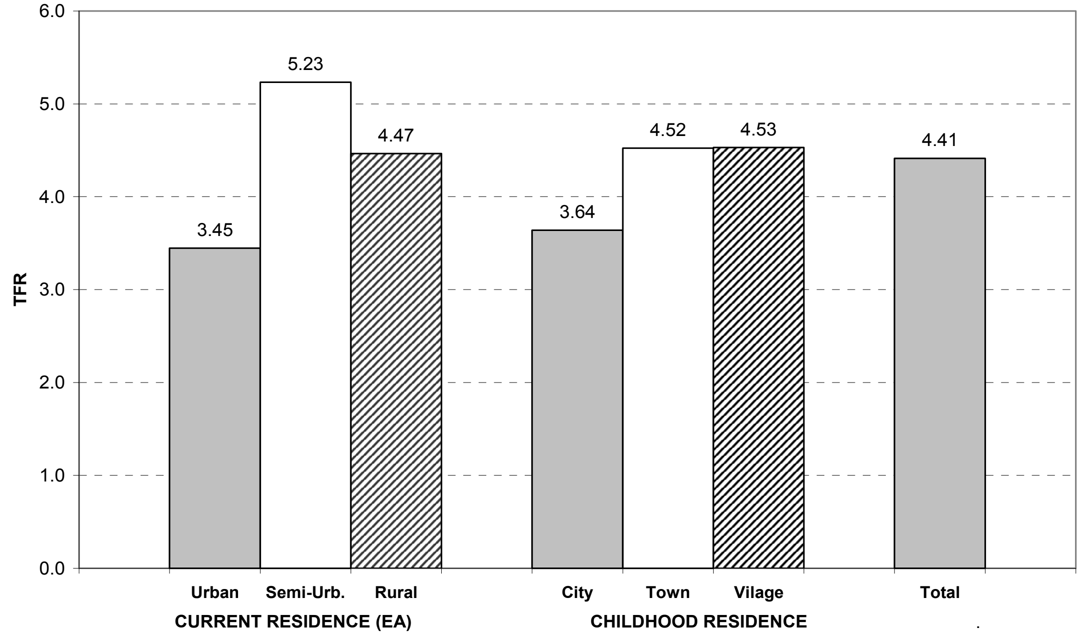
Figure 1. Total Fertility Rates (TFR) in Central Region, Ghana (1997-2001) by Current Residence and Childhood Residence up to Age 12



Notes: **Current residence** represents characteristics of each woman's community, whether Urban, Semi-urban, or Rural, determined by EA code.
Childhood residence represents a question asked of each respondent directly, variable w101: "*For most of the time until you were 12 years old, did you live in city, in a town or in a village.*"

Figure 2. Age Specific Fertility Rates in Central Region, Ghana (1997-2001) by Current Residence

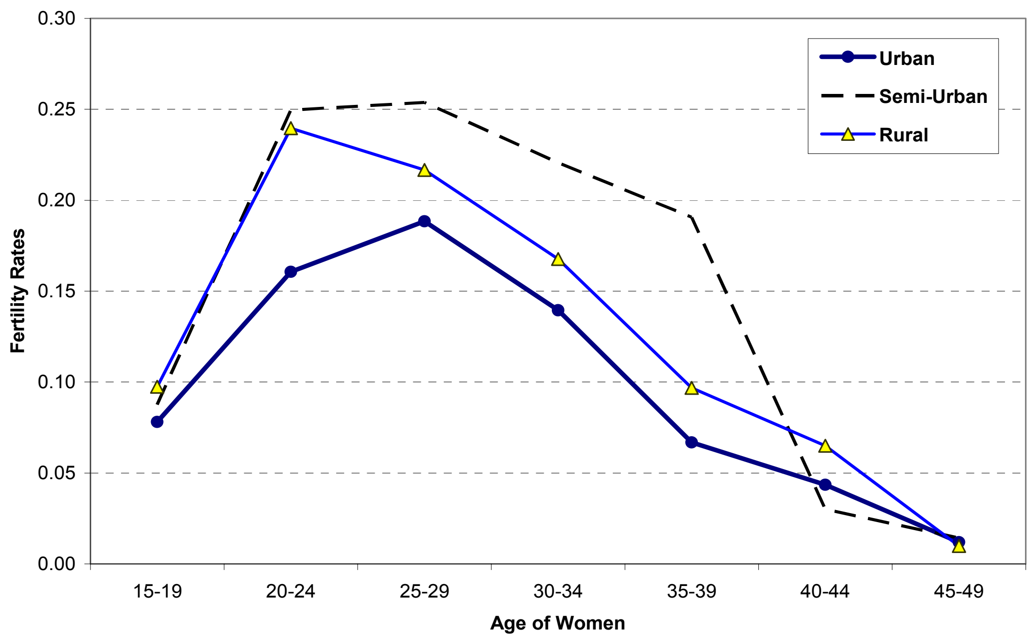
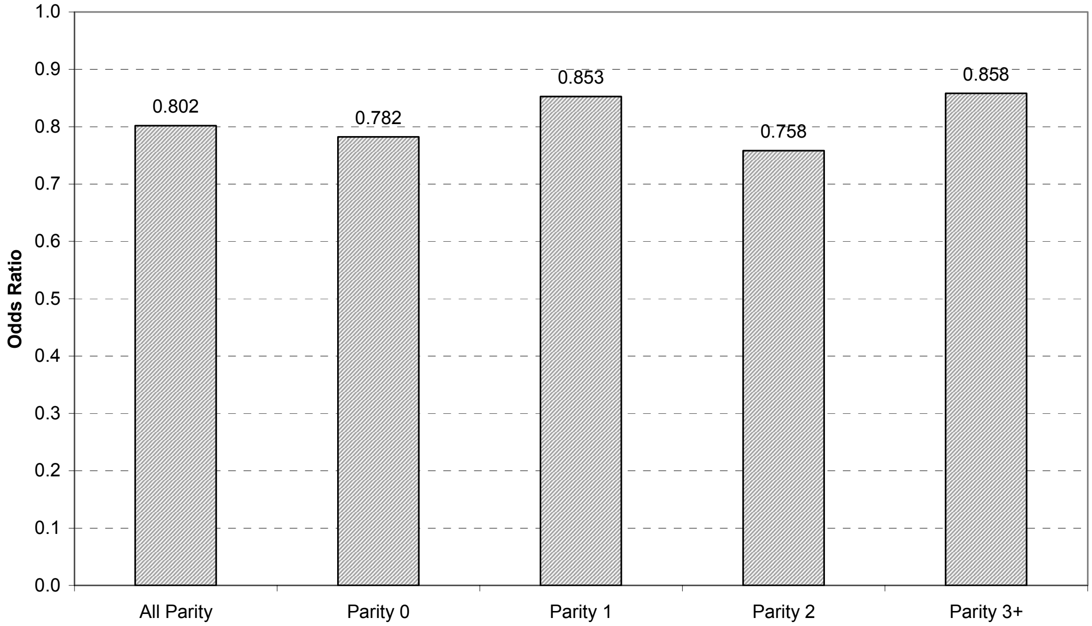
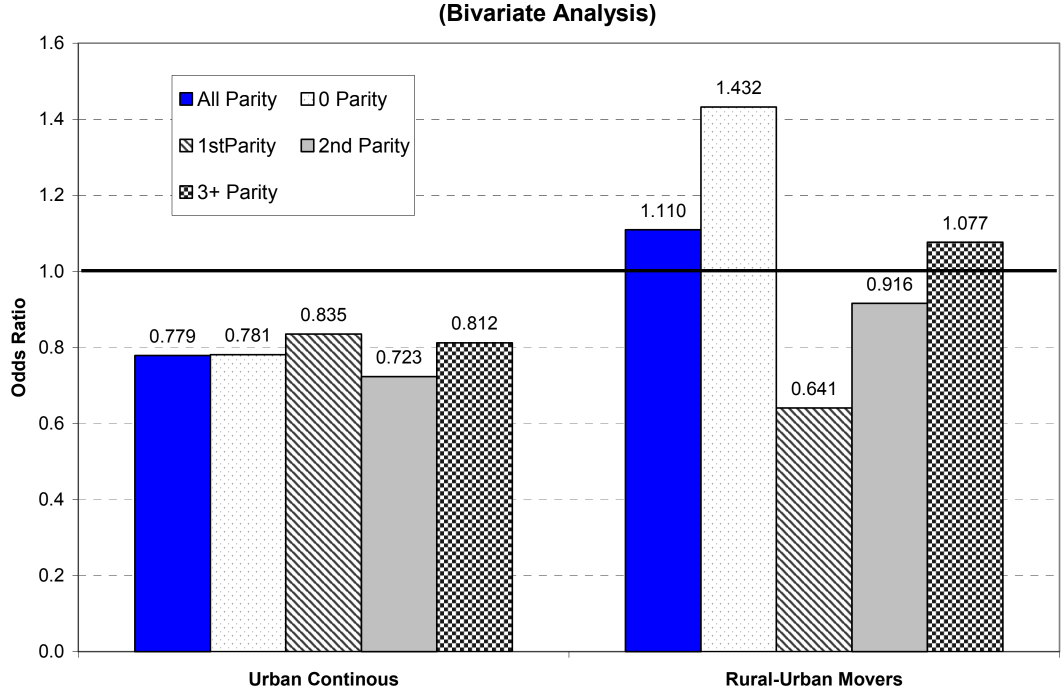


Figure 3. Odds Ratio by Birth Parity in Urban at time t-1 (Conception Time)



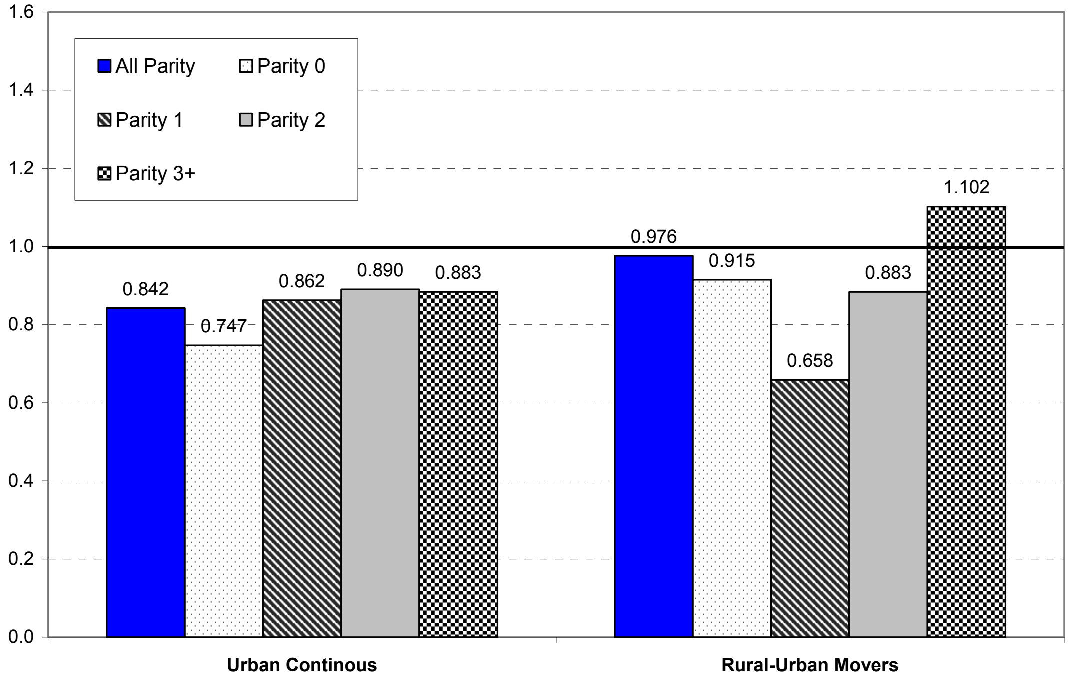
Note: Figure 3 was created by using the results from Model 1.1 (***Table 4***)

Figure 4. Odds Ratio by Birth Parity and Residential Mobility (Bivariate Analysis)



Note: Figure 4 was created by using the results from Model 1.2 (***Table 4***)
Rural continuous is a reference group (Odds Ratio = 1)

Figure 5. Odds Ratio by Births Parity and Residential Mobility (Multivariate Analysis)



Note: Figure 5 was created by using the results from Multivariate Event History Model (***Table 5***) Rural continuous is the reference group (Odds Ratio = 1)

Table 1. General Characteristics of the Sample (Women Age 15+)
2002 Ghana Population & Environment Survey

Characteristics	N Weighted	All (St. Dev)	15-49 (St. Dev)	50+ (St. Dev)	Min	Max
N for Age Group		1960	1532	428		
Proportion in Age Group	1960	1.000	0.782	0.218	0	1
		(0.000)	(0.413)	(0.413)		
Age (mean)	1960	36.37	28.71	63.78	15	98
		(17.46)	(9.49)	(10.58)		
Education						
None + Koranic	1960	0.388	0.283	0.764	0	1
		(0.487)	(0.450)	(0.425)		
Primary + Middle/JSS	1960	0.485	0.571	0.1785	0	1
		(0.499)	(0.495)	(0.384)		
Secondary + Higher	1960	0.1270	0.146	0.057	0	1
		(0.333)	(0.354)	(0.233)		
Fertility						
CEB (mean)	1960	3.418	2.427	6.966	0	15
		(3.184)	(2.471)	(2.913)		
Births last 5-year (mean)	1960	0.550	0.701	0.008	0	4
		(0.821)	(0.868)	(0.104)		
Parity distribution (2002)						
Parity 0	1960	0.257	0.322	0.021	0	1
		(0.437)	(0.468)	(0.144)		
Parity 1	1960	0.117	0.140	0.035	0	1
		(0.322)	(0.348)	(0.183)		
Parity 2	1960	0.114	0.137	0.030	0	1
		(0.318)	(0.344)	(0.172)		
Parity 3+	1960	0.512	0.400	0.913	0	1
		(0.500)	(0.490)	(0.281)		
Previous Residence						
Urban (t-1)	1960	0.575	0.596	0.496	0	1
		(0.495)	(0.491)	(0.501)		
Urban (age15)	1960	0.620	0.657	0.488	0	1
		(0.485)	(0.475)	(0.501)		
Duration in Central Reg.						
0-5 years	1960	0.185	0.206	0.112	0	1
		(0.388)	(0.405)	(0.314)		
6-15 years	1960	0.234	0.258	0.144	0	1
		(0.423)	(0.438)	(0.352)		
16+ years	1960	0.135	0.088	0.304	0	1
		(0.342)	(0.284)	(0.461)		
Since birth	1960	0.388	0.381	0.415	0	1
		(0.487)	(0.486)	(0.493)		

Table 2. Fertility Levels by Socioeconomic Indicators

	TFR (1997-2001)	**CEB** (Mean)	**5-year Fertility** (Mean)
SES (Possession Index)			
0 - 1	4.85	4.16	0.57
2 - 3	4.64	3.29	0.59
4 +	3.52	2.66	0.48
Education			
None + Koranic	5.12	5.17	0.49
Primary + JSS	4.51	2.45	0.63
Secondary + Higher	2.89	1.76	0.41

Notes: N (women) = by SES index (729, 618 and 612 women, respectively)
N (women) = by Education (759, 951 and 248 women, respectively)
N (persons year) = by SES index (2451, 2345 and 2488 person years, respectively)
N (persons year) = by Education (2277, 3874, and 1133 person years, respectively)

Table 3. Migration Patterns for Complete Sample (Women Age 15+)

Characteristics	N Weighted	All (St.Dev)	15-49 (St.Dev)	50+ (St.Dev)	Min	Max
Number of Inter-region Migration						
0 (never migrated)	1960	0.578 (0.493)	0.577 (0.494)	0.583 (0.494)	0	1
1 time	1960	0.182 (0.386)	0.207 (0.405)	0.095 (0.293)	0	1
2 times	1960	0.177 (0.382)	0.167 (0.373)	0.213 (0.410)	0	1
3 times	1960	0.028 (0.166)	0.025 (0.156)	0.041 (0.198)	0	1
More than 3x	1960	0.034 (0.180)	0.024 (0.153)	0.068 (0.252)	0	1
Age at migration (mean)						
1st migration	826	17.33 (10.46)	15.93 (9.15)	22.38 (13.09)	1	64
2nd migration	469	23.98 (11.85)	20.59 (8.06)	32.13 (15.13)	2	67
3rd migration	122	27.13 (10.78)	22.03 (6.47)	35.13 (11.33)	9	82
Residential sequences						
Born(0), Age15, Current						
U0– U15– UC	1960	0.472 (0.499)	0.506 (0.500)	0.353 (0.479)	0	1
U0– U15– RC	1960	0.065 (0.246)	0.064 (0.245)	0.067 (0.251)	0	1
U0– R15– UC	1960	0.004 (0.060)	0.004 (0.062)	0.003 (0.056)	0	1
U0– R15– RC	1960	0.025 (0.155)	0.031 (0.172)	0.003 (0.051)	0	1
R0– U15– UC	1960	0.048 (0.213)	0.051 (0.219)	0.036 (0.188)	0	1
R0– U15– RC	1960	0.035 (0.185)	0.037 (0.188)	0.030 (0.172)	0	1
R0– R15– UC	1960	0.047 (0.213)	0.033 (0.179)	0.097 (0.297)	0	1
R0– R15– RC	1960	0.304 (0.460)	0.275 (0.446)	0.409 (0.492)	0	1

Notes: R0 = Rural at birth (age 0) U0 = Urban at birth (age 0)
R15 = Rural at age 15 U15= Urban at age 15
RC = Currently Rural (at survey) UC = Currently Urban (at survey)

Table 4. Discrete Time Logit Event History Model (Dep. Var. = Birth)

	All Parities			**Parity 0**			**Parity 1**			**Parity 2**			**Parity 3+**		
Birth	Coef.	S.E		Coef.	S.E		Coef.	S.E		Coef.	S.E		Coef.	S.E	
Model 1.1															
Urban (t-1)	-0.221	0.037	***	-0.246	0.057	***	-0.160	0.080	*	-0.277	0.098	**	-0.153	0.054	**
Constant	-1.438	0.024		-1.939	0.039		-1.020	0.060		-1.055	0.066		-1.388	0.035	
Wald Chi^2(12)	35.68			18.79			4.01			7.91			8.05		
Prob> Chi^2	0.000			0.000			0.045			0.005			0.005		
Log likelihood	-13048.6			-3387.5			-2072.7			-1798.0			-5539.0		
Pseudo R^2	0.002			0.002			0.001			0.003			0.001		
Model 1.2															
Urban age15	0.129	0.067		0.660	0.193	***	-0.332	0.188		-0.071	0.159		-0.010	0.084	
Urban (t-1)	0.104	0.080		0.359	0.153	*	-0.444	0.200	*	-0.088	0.180		0.074	0.100	
Urb15*Urb(t-1)	-0.483	0.105	***	-1.266	0.245	***	0.596	0.270	*	-0.165	0.239		-0.272	0.132	*
Constant	-1.457	0.026		-1.983	0.039		-0.963	0.061		-1.042	0.075		-1.386	0.039	
Wald Chi^2(12)	62.54			48.15			9.54			8.88			16.15		
Prob> Chi^2	0.000			0.000			0.023			0.031			0.001		
Log likelihood	-13031.0			-3374.2			-2068.7			-1796.8			-5534.0		
Pseudo R^2	0.003			0.006			0.003			0.004			0.002		
# Obs.	**28213**			**9719**			**3699**			**3341**			**11454**		

***Note*: *** P < 0.001, ** P<0.01, * P<0.05**

Table 5. Discrete Time Logit Model (Dep. Var. = Birth)

Birth	All Parities			Parity 0			Parity 1			Parity 2			Parity 3+		
	Coef.	S.E		Coef.	S.E		Coef.	S.E		Coef.	S.E		Coef.	S.E	
Parity	0.065	0.012	***										0.012	0.020	
Age															
Age	0.436	0.017	***	0.937	0.070	***	0.516	0.061	***	0.305	0.062	***	0.300	0.038	***
Age^2	-0.008	0.000	***	-0.018	0.002	***	-0.011	0.001	***	-0.006	0.001	***	-0.006	0.001	***
Cohort															
Young Cohort	-0.339	0.051	***	0.224	0.106	*	-0.629	0.101	***	-0.519	0.122	***	-0.850	0.117	***
Middle Cohort	-0.254	0.039	***	0.395	0.095	***	-0.287	0.089	***	-0.430	0.106	***	-0.470	0.056	***
Residence (Urban)															
Urban Age15	0.072	0.062		0.395	0.173	*	-0.163	0.143		0.081	0.133		0.095	0.087	
Urban (t-1)	-0.024	0.075		-0.089	0.179		-0.418	0.169	*	-0.124	0.152		0.097	0.100	
Urb15*Urb(t-1)	-0.220	0.097	*	-0.598	0.247	*	0.433	0.219	*	-0.073	0.200		-0.316	0.132	*
Education															
Primary/Middle	-0.094	0.039	*	0.001	0.086		-0.232	0.084	**	-0.153	0.101		-0.156	0.065	*
Secondary+	-0.498	0.080	***	-0.734	0.143	***	-0.214	0.139		-0.545	0.207	**	-0.608	0.159	***
Constant	-6.925	0.231	***	-13.168	0.770	***	-6.601	0.780	***	-4.322	0.876	***	-4.634	0.640	***
Log likelihood	-12309.9			-3170.14			-1982.58			-1734.75			-5191.93		
Pseudo R^2	0.0584			0.0661			0.0445			0.0382			0.0635		
Wald Chi^2(12)	1148.61			372.21			176.16			108.68			537.35		
# Obs.	**28213**			**9719**			**3699**			**3341**			**11454**		

Notes**: ** P < 0.001, ** P<0.01, * P<0.05**

Cohort: Young cohort = born 1970 or later, Middle cohort = born 1950-1969, Older cohort (Reference group) = born before 1950.