Not Just When but Where:
Investigating internal migration fertility decline in West Africa

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Abstract

The dynamics of urbanization and urban growth in developing countries are not well understood, particularly the relationship between migration, urbanization and fertility. Here, I seek to determine if there is an "urban effect" on fertility (i.e. an association of urban residence and lower fertility exclusive of socio-demographic characteristics) discernable among internal migrants in West Africa. I also examine whether an urban effect is strongest among migrants to the largest urban areas (where fertility rates are lowest) and whether it is also apparent among migrants who move away from urban areas. I find that women who moved either to *or* from urban areas have lower annual odds of a birth compared to rural non-migrants and rural-to-rural migrants. Additionally, women who relocate to the largest cities have lower fertility than do migrants to smaller urban areas, suggesting that the association of urban residence on fertility is strongest where fertility rates are lowest.

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Introduction

Fertility in sub-Saharan Africa (SSA) has long been substantially lower in urban compared to rural areas (Kirk and Pillet 1998; Shapiro and Tambashe 2000; Shapiro and Tambashe 2002; Chattopadhyay, White and Debpuur 2006), with lower-fertility urban areas playing a key role in driving overall fertility decline at the national level in SSA (Romaniuk 2011; Shapiro and Tambashe 2002). Yet it is unclear whether the long-held lower fertility found in SSA's urban areas may be influenced by internal migration. Although urbanization is generally associated with lower fertility, migrant adaptation to new residence areas is not well understood, in particular how the process of a change in residence type impacts fertility behavior (National Research Council 2003; Beauchemin and Bocquier 2004; White, Muhidin et al. 2008). The lack of adequate data on internal migration in SSA (Schoumaker, Vause and Mangalu 2010) poses a particular challenge to producing evidence on the consequences of migration on fertility, accounting in part for the dearth of research on the migration-fertility relationship at the regional level. As a result, most current research on the region may be overlooking the role that that geographic mobility may be playing, directly or indirectly, in diffusing fertility decline at the national and regional levels

Understanding the relationship between urban migration and fertility decline is particularly relevant for SSA. The region is estimated to have high rates of internal migration, including urban-to-rural and horizontal migration, and is projected to have the world's fastest rates of urbanization and highest fertility in the coming decades (United Nations 2012). Though the majority of urban growth in most developing countries is believed to come from natural increase (Chen et al. 1998), increases in the proportion of young and female migrants throughout SSA (Brockerhoff and Yang 1994) means that in the coming decades a larger number of migrants will spend their reproductive years in cities, contributing to urban population growth indirectly through their reproductive behavior. A more nuanced understanding of migrant fertility behavior can contribute to the debate on whether internal migration is likely to make a positive contribution to fertility decline in SSA and, if so, whether this would be driven predominantly by migration to largest cities.

Here, I investigate whether internal migration is associated with changes in fertility behavior and whether an association of relocating to an urban area (with lower fertility) is greatest among those who move to the largest cities (where fertility rates are lowest). I investigate the relationship between residence in new areas post-migration and changes in fertility in the West African context by employing both descriptive and event-history methods using the latest demographic data on internal migration and fertility for West Africa. In a departure from most previous research on the fertility/migration residence, I not only consider rural-to-urban migrants but also ask if an urban effect is found among migrants who move away from urban areas and take up residence in rural areas. I also compare fertility behaviors of migrants in the short- and medium-term to discern if fertility patterns in the period immediately following migration change with increased duration in destination. This study is also the first to examine differences in fertility following residence in new areas in SSA at the regional level by looking beyond the urban/rural dichotomy and considering the difference in this relationship in cities of different sizes.

Theoretical Background

Lower fertility has long been associated with urban residence, an association that is believed to result from a combination of factors related to the costs of raising children, ideational change about family size and/or access to family planning. Housing, schooling and the overall cost of living tends to be higher in cities, generally making the cost of raising a child more expensive in urban than in rural areas (Easterlin 1975). Moreover, urban children do not usually contribute to agricultural production (Shapiro and Tambashe 2002) and are less likely to contribute to other forms of household production than their rural counterparts (White, Muhidin et al. 2008). More generally, favorable views on smaller family size are associated with higher levels of socio-economic development and female education generally found in cities (Cleland and Wilson 1987), while urban density presents greater opportunity for social interactions that encourage the diffusion of this ideational change (Bongaarts and Watkins 1996). Finally, urban residents tend to have better access to reproductive health services and modern birth control, particularly through the private sector (Cleland, Bernstein, Ezeh et al. 2006), making it easier for urbanites who wish to limit their fertility to do so.

While urban residence is generally associated with lower fertility, the relationship between migration and fertility is less clear, in particular how the process of a change in residence type impacts fertility behavior (National Research Council 2003; Beauchemin and Bocquier 2004; White, Muhidin et al. 2008). Evidence on the association of urban residence with migration and fertility in SSA is mixed. Most studies have found a positive association of urban migration and fertility decline (Chattopadhyay, White et al. 2006; White, Muhidin et al. 2008; Omandi and Ayiemba 2005; Brockerhoff 1998; Brockerhoff 1995), both for migrants themselves in the new place of residence (Brockerhoff and Yang 1994) and for subsequent generations born in the urban place of destination (White, Tagoe, Stiff et al. 2005). At least two studies of SSA, however, have found no association of migration and fertility decline or even an association of migration with increased fertility (Cleveland 1991; Lee 1992).

Explanations for the interrelationships between migration and fertility are guided by three main theoretical approaches: 1) the selection hypothesis; 2) the adaptation and/or socialization hypothesis; and 3) the disruption hypothesis. The selection hypothesis sees migrants as a self-selected group for whom lower fertility preferences are part of the motivation to move to a new area and whose fertility preferences are closer to those at the destination location even prior to migration (Kulu 2005). The socialization hypothesis predicts that the fertility of migrants will primarily reflect fertility preferences dominant in their place of origin, and that any changes in fertility behavior among migrants will only occur over the longer-term, for example among second generation migrants (White, Tagoe et al. 2005). Like the socialization theory, adaption theory holds that the fertility behavior of migrants will eventually come to resemble the dominant patterns of the destination location, but predicts a faster socialization and adaptation (Kulu 2005) and that convergence to fertility levels of the destination location will be seen among the migrants themselves. For SSA, the adaptation theory generally assumes improved knowledge of sources of family planning in urban areas (Brockerhoff 1995), and that fertility rates decrease following a move to an urban area due largely to increased acceptance of and access to contraception and abortion in urban areas

(Shapiro and Tambashe 1994). Finally, the disruption hypothesis postulates that migrants' fertility behavior will change in the period immediately prior to or following a residential change, primarily as a result of the disruption in economic and social support and family unification often involved in the process of migration itself (Kulu 2005).

These theoretical approaches to the relationship between fertility and migration can both contradictory and complementary. The inconsistent evidence on migration and fertility patterns highlights the complexity of the migration-fertility interaction and the difficulty of fitting all experiences under one theoretical framework, (Kulu 2005). For example, migrant selectivity has been cited as the underlying reason that migrants to urban areas have fertility behavior similar to rates found in destination cities in Ghana (White, Muhidin et al. 2008) and Thailand (Goldstein 1973). Alternatively Brockerhoff's 1995 study of thirteen SSA countries found support for the adaptation hypothesis by showing that fertility declined among most rural-to-urban migrants immediately after migration and remained low. While the disruption hypothesis is generally believed to act to lower fertility, due primarily to spousal separation (Kulu 2005), it has also been used to explain situations where fertility has increased following migration, as a result of disruption to breastfeeding and/or lack of or failure to access family planning services (White, Tagoe et al. 2005). That support found for and against all three theoretical approaches, often concurrently, suggests that the fertility-migration relationship is heavily context dependent (Brockerhoff and Yang 1994; Kulu 2005) and not necessarily generalizable from one area or region to another.

The Sub-Saharan African Context

In SSA, fertility has long been lower in urban than in rural areas. More recently, the region has recently experienced a widening in its long-held fertility differential, with fertility decline accelerated in most urban areas and stalling in rural ones (Kirk and Pillet 1998; Shapiro and Tambashe 2002). As a result, the migration and fertility interplay in SSA must be considered within the context of a region currently undergoing the fertility transition: rural-to-urban migrants are moving to locations that not only have lower relative fertility but are also experiencing relatively faster fertility declines than in rural areas. This likewise makes the reference category for fertility akin to a moving target for those relocating to or from urban areas, as fertility is not only relatively lower there than in rural areas but is also declining more rapidly.

Fertility is lower in SSA's largest cities compared to other urban areas (Cohen 1993), often by more than one child (Shapiro and Tambashe 2002). Despite this notable differential, scant attention has been paid in the literature to fertility differentials by city size in SSA, with the exception of a few studies that have segmented capital cities. Yet relying on this strict urban/rural dichotomy implies that most research supposes that the relationship between migration and fertility is uniform across all areas defined as urban, potentially obscuring important subtleties in the association of migration and urban residence with fertility decline in SSA.

Furthermore, the literature on the linkages between urbanization, migration, fertility in SSA has focused almost exclusively on an upward rural-to-urban trajectory (Goldstein 1973; Brockerhoff and Yang 1994; White, Muhidin et al. 2008). A recent notable exception is Chattopadhyay, White et al. (2006) who included urban-to-rural migrants in their analysis of Ghana. This nearly-singular focus on urban-bound migrants implicitly assumes that any impact of urban migration on fertility is found exclusively in urban areas and fails to account for the growing importance of other streams of migration within SSA. Data needed to estimate rates and levels of internal migration is hard to come by for the region, but some research points to increases in urban out-migration and return migration from urban to rural areas (Beauchemin and Bocquier 2004), circulatory and temporary migration, and intra-rural and intra-urban migration in SSA (Oucho and Gould 1993). Two recent studies on SSA found that rural areas were the principal destination among internal migrants in (Chattopadhyay et al. 2006, Oucho and Gould 1993). This evidence of potentially high levels of migration to and within rural areas, not just to urban areas, suggests that focusing exclusively on city-ward migration may lead to incomplete and overly simplistic explanations of the relationship of migration and fertility.

Accounting for circular or temporary migration, however, poses a specific challenge to examining the longer-term effect of migration on fertility in SSA, for reasons that are both theoretical and practical. Theoretically, the mechanisms by which migration may influence fertility may be different among circular or temporary migrants – particularly for adaptation which is usually a gradual process and may not impact migrants who stay for shorter periods. For example, migrants who know a move is temporary may have lower motivation for adaptation (Chattopadhyay, White et al. 2006). Alternatively, any exposure to lower fertility norms in urban areas –however temporary– may affect fertility behavior of rural return migrants. More practically, DHS data does not directly account for these types of migration and without comprehensive migration histories it is extremely challenging, if not impossible, to parse out the circular and temporary migrants from long-term or permanent migrants. In this study, I am not able account for circular migration but instead try to separate more temporary from permanent (or more long-term) migrants by including length of time at destination place.

Within SSA, I focus specifically on West Africa. An investigating differences in migration and fertility outcomes is particularly relevant for this sub-region, which has the continent's highest fertility rates and highest projected rates of urbanization and population growth for the next two decades (United Nations 2012). I also choose to limit my analysis to one region of SSA in order to eliminate possible regional differences and include countries that are contiguous with a defined geographic area.

The Present Study

This study has three hypotheses. First I anticipate that internal migrants in West Africa will exhibit fertility behavior that differs from non-migrants in their places of origin. Second, compared to rural non-migrants, I expect to find a general negative association of migration with fertility for both upwards (rural-to-urban) and downward (urban-to-rural) migrants. Relatedly, I also anticipate that horizontal migrants (within the same residence type, e.g. rural-to-rural) will have similar fertility rates as non-migrants in these residence areas. Third, I predict that the association of rural-to-urban migration and lower fertility will be strongest among rural migrants who move to the largest cities, where fertility is lowest, than among those who move to smaller urban areas.

My aim in this study is to assess how residence in new areas alters the longer-term fertility behavior of migrants, rather than how the process of migration impacts fertility outcomes around the time of the move. Thus, my primary interest is in longer-term fertility outcomes of more permanent migrants, not temporary changes in fertility outcomes due to process of migration itself. This paper is a departure from most previous studies of the migration-fertility interrelationship in SSA because it considers both upward and downward migration and examines the relationship of new residence and fertility change by employing a division of urban areas by size.

Data

I use 26 Demographic and Health Survey (DHS) datasets carried out between 1990-2008 from eleven countries in West Africa (Table 1). The DHS collects nationally representative data in less developed countries through household sample surveys that measure health, population, and socioeconomic indicators, with a focus on maternal and child health (Rutstein and Rojas 2006). All surveys include a representative stratified probability sample of all women of reproductive age (15-49) and collect detailed data on maternal and child health, fertility, and family planning, including a complete birth history for each woman, detailing the month and year of birth, sex, age and survival status of every child a woman has had.

DHS surveys also obtain data on the demographic characteristics of respondents (including age, level of education, employment and marital status) and respondents' household characteristics (including household infrastructure, electrification, access to safe water and sanitation). To approximate a relative measure of wealth at the household level, the DHS creates a household wealth index based on a principal component analysis of common household assets within a country, with households divided into five quintiles, (Rutstein and Johnson 2004). All respondents are coded as living in urban or rural areas; some, but not the majority, of surveys include a more detailed break-down of residence with variable (*v026*), which classifies respondent residences as: "capital/large city", "small city", "town" or "countryside". In this study, only surveys up to 2008 are included because as of 2009 the DHS core questionnaire (the model questionnaire designed by DHS on which the country-specific questionnaires are based) no longer includes questions related to migration and residence changes.

Table 1: DHS datasets included in the analysis

Country	Year	DHS sample (women 15-49)
Benin	1996	5,488
Benin	2001	6,219
Benin	2006	17,794
Burkina Faso	1993	6,354
Burkina Faso	2003	12,477
Ghana	1993	4,562
Ghana	1998	4,841
Ghana	2003	5,637
Ghana	2008	4,878
Guinea	2005	7,951
Liberia	2007	7,018
Mali	1996	9,704
Mali	2001	12,849
Mali	2006	14,336
Niger	1992	6,503
Niger	1998	7,575
Niger	2006	9,021
Nigeria	1990	8,781
Nigeria	1999	9,805
Nigeria	2003	7,620
Nigeria	2008	32,856
Senegal	1993	6,310
Senegal	1997	8,592
Senegal	2005	14,181
Sierra Leone	2008	7,283
Togo	1998	8,569
Total		246,894

Cote d'Ivoire (all surveys), Guinea (1999) and Burkina Faso (1998-99) are not included because those surveys did not contain migration-related variables.

Prior to 2008, the DHS core questionnaire included a series of questions that can be used to identify migrants. Respondents are first asked "Have you always lived in this place?" *(v106)*. Those who answer "no" are then asked, "How long ago did you move to this place?"

(v104), which is recorded in years, and "What was the type of place in which you previously lived?" *(v105)*, usually coded as "capital/large city", "small city", "town" or "countryside". This does not provide a comprehensive migration history –and does not account for multiple moves or circular migration– but nonetheless identifies those who have moved at least once and when, allowing for a category of lifetime migrants. DHS includes a question on "type of place of childhood residence" (*v103*), in which respondents specify what type of place (city, town or countryside) they spent most of their childhood in until age 12; however this variable is excluded from nearly half of the surveys and is subject to both greater recall bias and inaccuracies due to reclassification of areas in the time since respondents' lived in these areas. For these reasons, I create migrant categories based on current and last place of residence and include *v103* only as a control variable.

Migrant Stream Categories

I divide residence area types into three categories: rural, smaller cities, largest cities. As a first step, I use the urban and rural designations from the DHS[1]. I then further segment "largest cities," from other urban areas. The largest cities are defined here as those having populations of one million or greater at the time of each DHS based on the United Nations Population Division population estimates. Survey clusters that fall into the largest city category are identified using the residence variable *v026* (where it is included) or with regional/provincial identifiers of survey clusters (where this does not uniquely identify a large urban area, clusters are spatially located within an urban area using ArcGIS).

I then create twelve distinct categories of migrant status. Migrants are defined by place of origin (type of place of previous residence) and destination (current residence), with migrants defined as respondents who have lived in their current place of residence for fewer than 9 years. These twelve migrant categories include three categories of non-migrants and all nine origin/destination combinations of these residence categories, including horizontal migrants within the same residence area type (e.g. rural-to-rural migrants) (Table 2). Only

[1] As there is no international or standardized definition of urban and rural (unstats.un.org/unsd/demographic/sconcerns/densurb/densurbmethods.htm), the DHS relies on each country's administrative definition for designating areas and survey clusters as urban or rural.

internal migrants are included in this analysis as migrants whose last place of residence was another country have their place of origin listed only as "abroad" (without any information on the country or residential type).

Table 2: Migrant categories for women in the sample

Migrant category*	All women		Migrants only	
	n	%	n	%
Rural Non-migrant	109,080	*45.2*		
Small Urban Non-migrant	36,238	*15.3*		
Large Urban Non-migrant	17,498	*7.0*		
Rural → Rural	29,135	*12.1*	29,135	*37.2*
Small Urban → Rural	13,689	*5.7*	13,689	*17.5*
Small Urban → Small Urban	12,121	*5.0*	12,121	*15.5*
Small Urban → Large Urban	7,894	*3.2*	7,894	*10.1*
Rural → Small Urban	6,530	*2.7*	6,530	*8.3*
Rural → Large Urban	3,043	*1.3*	3,043	*3.9*
Large Urban → Rural	2,457	*1.0*	2,457	*3.1*
Large Urban → Small Urban	1,998	*0.8*	1,998	*2.6*
Large Urban → Large Urban	1,443	*0.6*	1,443	*1.8*
N	**241,126**	*100.0*	**78,310**	*100.0*

Source: Demographic and Health Surveys (1990-2008)
*Migrants who have relocated from abroad are not included (as neither the country of origin nor the type of previous residence in these countries can be identified and out-migrants abroad are not accounted for in the DHS).

Methods

Descriptive analysis

Descriptive statistics of socio-demographic characteristics for respondents are presented first for non-migrants in rural and urban categories, and then disaggregated for all migrant categories. The descriptive overview includes counts and proportions of all migrant and non-migrant categories and descriptive statistics of socio-demographic variables of respondents at the time of the survey. Where there are multiple surveys per country, only the most recent survey is used for the descriptive overview. Statistics are presented for the pooled sample of all women and are weighted at the country level to account for the multistage sampling design and at the regional level by country population.

Analysis of Fertility Outcomes

Age-specific fertility rates (ASFR)

As a descriptive overview of fertility across the regions, I graph age-specific fertility rates (ASFR) by migrant stream, to determine whether different migrant categories have distinct age-specific fertility patterns. ASFRs are calculated by dividing the number of births to women in a specific age group (usually five-year age groups from 15-49) by the number of person-years lived by all the women in that age group for the three year period preceding each survey.

Cumulative Fertility

For a more detailed multivariate fertility overview, I use Poisson models of cumulative fertility comparisons. The outcome variable is children ever born (at the time of the survey) and I control for age, age squared, education level, wealth quintile, marital status and childhood type of place of residence. I run the Poisson model for the different migrant categories and length of duration in place of destination.

These estimates of ASFR and Poisson regression of cumulative fertility serve largely as a descriptive overview of migrant fertility. While ASFRs can provide a snapshot of fertility for a particular period, they are highly susceptible to changes in the age patterns and timing of childbirth, and can differ substantial from lifetime fertility measures when there are shifts in the age-patterns of fertility over time. Cumulative fertility likewise only measures fertility at the time of the survey, and may misrepresent overall fertility levels if there are different age patterns of childbearing (even when controlling for age).

A more accurate measurement of lifetime fertility for comparing difference among migrant groups would be the completed fertility rate (CFR) (the average number of births by a cohort of women at the end of their reproductive lives). The CFR, however, reflects the past experiences of older women and largely neglects current fertility trends as it does not measure the fertility of younger women (Parrado 2011). The CFR may thus also under-estimate current "urban" effects on lower fertility by failing to capture the full extent of current trends in the interrelationship of migration and fertility in a regions like West Africa, that are experiencing rapid urban fertility decline and a widening of urban/rural fertility differential. More practically, using CFR here would result in inadequate sample sizes for most migrant stream categories, as the DHS only interviews women of reproductive ages and CFR would be calculated from only the small proportion of the oldest women in the survey.

Discrete time logit and conditional logit models

I employ two discrete time event history models where the dependent variable is whether or not a woman gives birth in a particular year and control variables are the same as those used in the Poisson regression. The DHS data on fertility can be linked to the timing of migration by matching birth histories with the calculated year of migration (year of survey minus years lived in current place of residence for migrants). Here, I use a discrete-time framework with a person-year data structure. Each person-year for the ten years prior to the survey forms a record, allowing me to estimate annual birth probabilities using logistic regression. This produces 2,411,260 records for 241,126 individual women. Creating person-year files for the ten years previous to the survey results in some person-year files for women as young as 5; while there are certainly instances in which women give birth prior to 15, this is relatively rare (even in SSA) and does not factor into the ASFR calculations. Thus, women are left-censored into the data set only when they reach age 15, which reduces the total number of records in the dataset to 1,856,512 person-year records.

Each record contains a set of both constant and time-varying covariates. Constant variables are those measured only at the time of survey: highest level of completed education and household wealth. The time-varying covariates, those that include information on dates/timing that allows them to change from record to record for each individual, are: residences, year of migration, marital status, whether a woman gave birth that year and her parity. Parity is broken down into three categories: no births, first birth and all higher order births. Parity is lagged by one year so that a woman's parity only increases the year after she gives birth.

Measuring the impact of residence in a new location following migration requires identifying the following counterfactual: what would a woman's fertility *have been* had she *not* changed residence? There are two options for approximating this counterfactual: 1) using a discrete time logit model to comparing a migrant with women of similar socio-demographic profiles who did not move or 2) employing a discrete time conditional logit model to contrast an individual woman's fertility before and after her migration (assuming that any changes in her fertility following migration are due to influences in her new place of residence).

A discrete time logit model permits comparisons of fertility outcomes) among migrants and non-migrants. By calculating annual birth probabilities, rather than cumulative fertility, the fertility of migrants in their places of destination can be compared with that of non-migrants from their places of origin. This provides a more direct comparison of actual fertility rates in places of origin and destination among migrants and non-migrants, with non-migrants serving as the counterfactual for fertility in the absence of a change of residence. To compare fertility outcomes prior to and following a move for migrants, I also run discrete-time models for migrants for the periods before and after migration, and compare the results to see if those who do move exhibit higher or lower fertility prior to moving, which could reflect either anticipatory fertility, disruption or selection. Although this model provides a comparison of fertility differences for migrants in their new places of residence with non-migrants from their places of origin, it does not provide a direct comparison of an individual's fertility before and after changing residence because the model does not allow for fixed effects while accounting for complex survey design.

Discrete time conditional logit models, on the other hand, can include fixed effects with complex survey data, providing a more direct comparison of fertility changes for an individual following a change of residence by controlling for unobserved individual-level characteristics. Specifying individual-level fixed effects in the model automatically controls for all unobserved differences between individuals that are stable (time-invariant), regardless of whether or not these differences are related to the likelihood of an event occurring (Allison 1994). In this case, the event is moving to a new residential area (migration), and the model allows for residence to be a time-varying covariate that can occur at different time periods for different individuals. As the outcome is dichotomous in each person-year file (0=no birth in that year, 1= a birth), I use a conditional likelihood logit model.

Relying solely on the results the discrete time conditional logit model, however, is complicated here by two factors. First, while model can control for both constant and time-varying covariates, it can only produce estimates for those variables that change over time, and thus cannot provide estimates for non-migrants, eliminating them as a reference category. Second, the age pattern of fertility may compromise the accuracy of comparing a woman's fertility pre- and post-migration as most respondents who change residence do so when they are young, before the peak childbearing years. So while a discrete-time conditional logit may capture differences in fertility outcomes prior to and following a residential change, it may also be confounding these changes with both overall age patterns of fertility and changes in the tempo of fertility (particularly if women who delay their first birth ultimately have fewer children on average than those who begin childbearing earlier).

I run both logit and conditional logit models and use results from both models to form both population profile and individual-level counterfactuals against which to compare post-migration fertility among women who have changed residence. All models are run first for all migrant categories and then separately by length of time in current residence (0-2 years, 3-5 and 6-8) and on the pooled sample include country-level fixed effects, country-specific sampling weights (to account for the multistage sampling design and by country population at the regional level.

Results and Discussion

Descriptive statistics

Sample characteristics (Table 3 and 4) show that on average, recent migrants are younger, more likely to be childless and have fewer children than migrants who have lived in their place of destination for longer. Newer migrants are slightly better educated than longer-term migrants, which may be in part increased levels of female education across the region. Somewhat surprisingly, rural women who move to large cities have among the lowest average number of children ever born and are more likely to be childless and unmarried than most other migrant categories (including rural-to-small urban). Women who move from urban areas (large or smaller) to rural areas have less education, more children and are more likely to be married than urban women who migrate to other urban areas. Migrants who move horizontally between small urban areas have higher cumulative fertility than those moving from small to large urban areas. There is some change in the profiles and ordering of migrant categories across different duration periods, indicating a timing element (and perhaps high proportion of circular or return migration) may be at play.

Table 3: Descriptive statistics for non-migrants for eleven West African Countries

Non-Migrants	CEB (mean)	Age (mean)	Educ. (mean)	Parity=0 (%)
Rural Non-migrant	3.83	30.4	0.6	21.1
Large Urban Non-migrant	2.02	28.7	1.5	37.4
Small Urban Non-migrant	2.89	29.0	1.2	32.9
Average	2.91	29.4	1.1	**30.5**

Source: Demographic and Health Surveys (1990-2008)
Education levels: no education=0, primary school=1, secondary school=2, higher=3

Table 4: Descriptive statistics by migrant category for eleven West African Countries

	6-9 years since migration				**2-5 years since migration**				**0-1 years since migration**			
Migrant Category	**CEB (mean)**	**Age (mean)**	**Educ. (mean)**	**0 parity (%)**	**CEB (mean)**	**Age (mean)**	**Educ. (mean)**	**0 parity (%)**	**CEB (mean)**	**Age (mean)**	**Educ. (mean)**	**0 parity (%)**
Rur → Rur	3.40	27.5	0.40	17.8	2.40	25.2	0.50	14.6	1.70	23.7	0.70	36.4
Sm Urb → Rur	2.72	28.1	1.00	44.3	1.90	25.1	0.90	32.0	1.30	24.1	1.10	56.0
Rur → Sm Urb	3.00	27.8	0.90	30.4	2.20	25.7	1.10	29.7	1.70	24.7	1.20	42.6
Lg Urb → Rur	2.23	30.1	1.70	38.1	1.80	28.5	1.80	37.2	1.50	26.6	1.70	44.2
Sm Urb → Sm Urb	2.64	28.6	1.50	33.7	2.10	27.3	1.60	31.8	1.60	25.8	1.70	41.0
Lg Urb → Lg Urb	1.92	26.7	1.10	34.5	2.40	28.3	0.90	29.8	1.30	26.6	0.99	43.8
Rur → Lg Urb	2.40	28.7	1.00	35.3	1.80	27.0	1.10	34.1	1.70	25.8	0.99	42.9
Lg Urb → Sm Urb	2.85	27.7	0.60	30.3	1.90	25.1	0.50	27.2	1.30	22.7	0.60	42.6
Sm Urb → Lg Urb	3.14	28.9	0.90	25.7	2.30	27.2	1.20	24.7	1.70	25.6	1.38	35.6
Average	2.70	28.23	1.01	2.70	2.40	25.2	0.5	24.3	1.53	25.07	1.15	42.8

Source: Demographic and Health Surveys (1990-2008)
Education levels: no education =0, primary school=1, secondary school=2, higher=3

ASFRs

Migrants to and non-migrants in urban areas tend to have lower ASFRs at all ages (Figure 1). Generally speaking, those in rural areas –migrants and non-migrants– Migrants who move from rural to large urban areas have much lower ASFRs than any other category that originates in or migrates to rural areas. Rural-to-rural horizontal migrants show the highest fertility at younger ages and small-to-large urban migrants have lowest the ASFR of any group at nearly every age, including non-migrants in the largest urban areas. ASFRs are largely descriptive and cannot give us substantial insight into lifetime fertility outcomes, but they nonetheless suggest substantial variations in the age patterns of fertility by migrant category and that these differences warrant further investigation.

Figure 1: Age-specific fertility rates by migrant category (0-8 years in place of destination)

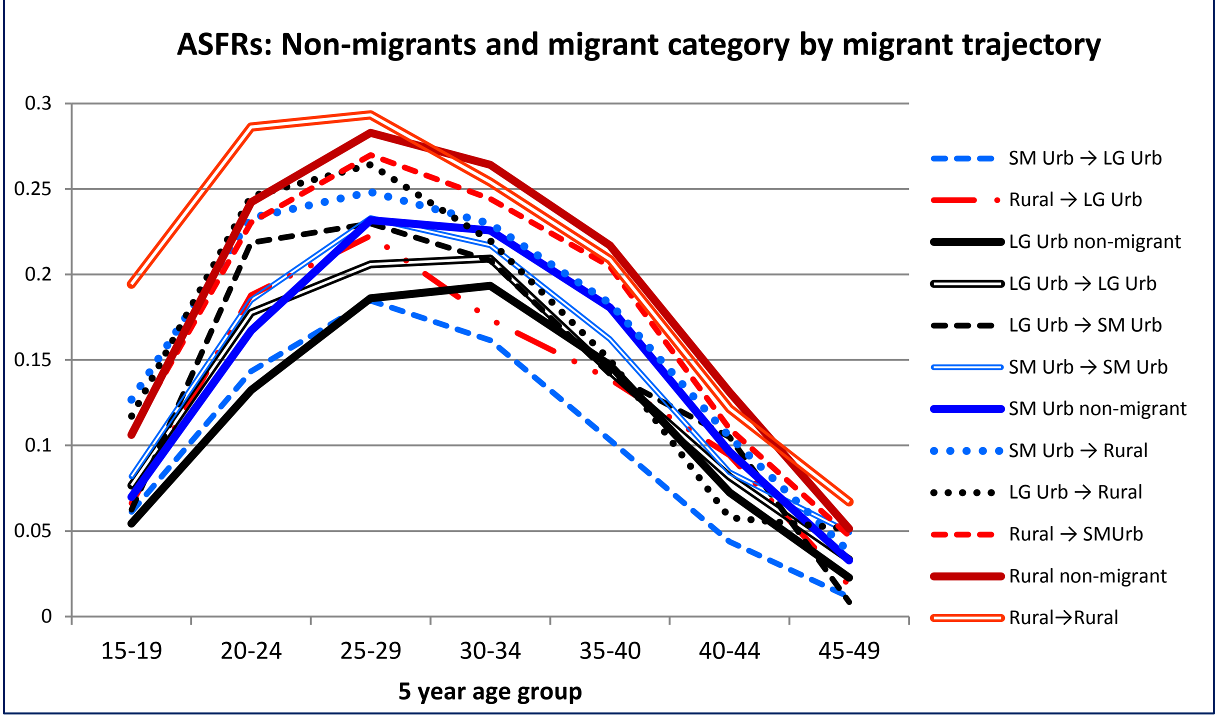

Table 5 displays results from the Poisson model for cumulative fertility for all migrant categories (migrants and non-migrants). Model one includes only age and age squared. Model two adds socio-demographic variables known to be associated with fertility: education, wealth and marital status. The third model adds the childhood type of place of residence. As with ASFR, small-to-large urban migrants show the lowest cumulative fertility of all migrants. Migrants who move to or from the largest cities have the lowest cumulative fertility, - with the exception of large urban-to-rural downward migrants. Childhood residence in a large city is significantly associated with lower cumulative fertility, although this variable to the model does not change the direction of any of the coefficients for residence and only alters slightly the magnitude of some. As a result of the relatively small influence this variable, combined with the limited number of surveys in which it is included and potential recall bias, I do not include it the following steps of the analysis.

Table 5: Poisson model of cumulative fertility by migrant status (0-9 years since last move)

	Model 1		Model 2		Model 3	
Migrant category (ref: rural non-migrant)						
Large Urban Non-migrant	-0.390	***	-0.117	***	-0.122	***
Small Urban Non-migrant	-0.162	***	-0.017		-0.030	*
Rural → Rural	0.024	*	-0.062	***	-0.059	**
Rural → Small Urban	-0.152	***	-0.063	**	-0.084	*
Small Urban → Rural	-0.179	***	-0.108	***	-0.102	***
Large Urban → Rural	-0.185	***	-0.127	***	-0.094	***
Small Urban → Small Urban	-0.360	***	-0.137	***	-0.166	***
Rural → Large Urban	-0.329	***	-0.147	***	-0.213	***
Large Urban → Large Urban	-0.482	***	-0.243	***	-0.220	***
Large Urban → Small Urban	-0.428	***	-0.201	***	-0.190	***
Small Urban → Large Urban	-0.554	***	-0.267	***	-0.273	***
Age	0.355	***	0.256	***	0.266	***
Age-squared	-0.004	***	-0.003	***	-0.003	***
Education level			-0.140	***	-0.130	***
Household wealth			-0.025	***	-0.024	***
Marital status			2.125	***	2.414	***
Childhood residence (ref: rural)						
Small urban area					0.004	
Large urban area					-0.048	**

Source: Demographic and Health Surveys (1990-2008)
All models include country-level fixed effects
Coefficients; * p<.05, ** p<.01, *** p<.001

Discrete time logit model of fertility

Table 6 displays results of three discrete-time logit models of the annual probability of a birth by migrant and non-migrant categories. The first model one includes migrant category, age and age squared. Model two adds two time-varying covariates: marital status (moving from never-married to ever-married) and parity. The third model adds highest level of education achieved and household wealth (as measured at the time of the survey).

Table 6: Discrete-Time Logit Model for Fertility (annual probability of a birth)

	Model 1		Model 2		Model 3	
	Odds Ratio		*Odds Ratio*		*Odds Ratio*	
Migrant status *(Ref: rural non-migrant)*						
Small urban non-migrant	0.711	***	0.845	***	0.917	***
Large urban non-migrant	0.513	***	0.717	***	0.817	***
Rural → Rural	1.108	***	0.957	**	0.989	**
Rural → Small urban	0.857	***	0.917	***	0.993	
Rural → Large urban	0.614	***	0.807	***	0.916	*
Small urban → Large urban	0.563	***	0.780	***	0.920	**
Small urban → Small urban	0.712	***	0.900	***	1.003	
Large urban → Large urban	0.545	***	0.743	***	0.890	**
Large urban → Small urban	0.626	***	0.820	***	0.907	*
Large urban → Rural	0.801	***	0.881	***	0.901	***
Small urban → Rural	0.869	***	0.924	***	0.965	*
Age	0.975	***	0.915	***	0.918	***
Age squared	1.001	***	1.000	***	1.001	***
Married (ref: unmarried)			16.167	***	15.494	***
Parity (ref: 0)						
1			1.167	***	1.159	***
2 and higher			1.270	***	1.237	***
Education (ref: no education)						
Primary					1.031	*
Secondary					0.948	***
Higher					0.835	***
Household wealth *(ref: poorest)*						
Poor					0.982	
Middle					0.940	***
Rich					0.901	***
Richest					0.824	***
Intercept	0.422	***	0.120	***	0.125	***

Source: Demographic and Health Surveys (1990-2008).
All models include country-level fixed effects
* p<.05, ** p<.01, *** p<.001

When controlling only for age and aged squared, every migrant category has annual birth probabilities that are statistically significantly different (p<.001) from the reference category of rural non-migrants, the exception of rural-to-rural migrants whose annual odds of a birth are lower for all migrant categories compared to rural-non-migrants. The differences are attenuated with the addition marital status and parity, both of which substantially increase the likelihood of a woman giving birth in a particular year. The association marital status and fertility is particularly strong, suggesting that few births happen (or are reported) out of wedlock. When education and household wealth are added, rural-to-small urban and small urban horizontal migrants' annual birth probabilities are no longer significantly different from that of rural non-migrants. For all other categories, however, annual birth probabilities are lower, for large urban non-migrants and large urban horizontal migrants. Among women who moved to large cities, those from rural areas have lower annual birth probabilities than those from small urban areas, though the difference is slight.

Table 7: Discrete-time logit model for migrants: comparison of birth probabilities in year *t* before and after migration

Migrant category			Pre-migration *(origin)*		Post-migration *(destination)*	
Ref: Rural	→	*Rural*				
Rural	→	Small urban	1.043		0.965	
Rural	→	Large urban	1.036		0.811	***
Small urban	→	Large urban	0.896	*	0.822	***
Small urban	→	Small urban	1.024		0.938	
Large urban	→	Large urban	1.002		0.831	***
Large urban	→	Small urban	1.066		0.842	***
Large urban	→	Rural	1.000		0.950	
Small urban	→	Rural	0.971		0.962	

Source: Demographic and Health Surveys (1990-2008).
Models control for age, age squared, education, household wealth, marital status, and parity (first and higher order births) and include country-level fixed effects
Odds ratios; * p<.05, ** p<.01, *** p<.001

Table 7 uses the full model from Table 6 above to compare the annual birth probabilities in the period prior to and following their migrations, to examine whether there is a discernable selection effect (for higher or lower fertility) among those who change residence prior to their moves. The reference category here is rural-to-rural migrants as now only migrants are included.

Prior to moving, only migrants from small-to-large urban areas show significantly different (lower) annual odds of having a birth compared to rural-to-rural migrants. When we look at the post migration period, however, small-to-large urban migrants have even lower odds of having a birth in a given year than prior to the move. Three other migrant categories show statistically lower annual odds of a birth, all of which have a large urban area as origin or destination. Except for migrants from large-to-small urban areas, respondents who moved to small urban or rural areas (downward or horizontally) do not have significantly lower annual odds of a birth than do rural-to-rural migrants. This finding seems contrasts the most comparable study of migration in SSA (Brockerhoff and Yang 1994) that found that rural-to-urban and urban-to-urban migrations had higher fertility than non-migrants in the years just prior to migration.

Table 8: Discrete-time logit model of odds of a birth in year *t* for all migrant categories by duration at place of destination

Migrant Category		0-1 years		2-5 years		6-9 years	
		Odds Ratio		*Odds Ratio*		*Odds Ratio*	
Ref: Rural	→ *Rural*						
Rural	→ Small urban	0.847		1.049		0.917	
Rural	→ Large urban	0.750		0.880		0.852	
Small urban	→ Large urban	1.013		0.864	**	0.855	**
Small urban	→ Small urban	1.212		1.001		0.893	**
Large urban	→ Large urban	1.062		0.908		0.862	*
Large urban	→ Small urban	1.376	*	0.966		0.777	**
Large urban	→ Rural	1.075		0.987		0.962	
Small urban	→ Rural	1.263	*	0.996		0.957	

Source: Demographic and Health Surveys (1990-2008)
Models control for age, age squared, education, household wealth, marital status, and parity (first and higher order births) and include country-level fixed effects
Odds ratios; * p<.05, ** p<.01, *** p<.001

Table 8 shows annual birth probabilities by duration in the place of new residence, to determine whether there are markedly different patterns over time, primarily to see if there is strong evidence of disruption in the period immediately following migration that may account for the overall decreases in annual birth odds of migrants. If so, this would make a strong case for the disruption hypothesis, and catch-up fertility due to marriage-related migration or reuniting of spouses and would suggest that residence the (new) place of destination has less of an impact on fertility than does the process of, and disruption around, migration itself. We do see some evidence of increased birth odds in the two years immediately following migration but only for two groups – notably, the only two downward migration categories (large-to-small urban and small urban-to-rural). There is no convincing time trend across migrant groups, although intra-urban migrants (to, from and between small and large urban areas) do show greater decreases annual birth odds among those who have resided in their places of destination the longest.

While this model seems to provide a good approximation for measuring the effect of new residence on fertility outcomes, it does not measure this change directly for individuals. Instead, this is done with a conditional logit model (Table 9) with individual-level fixed effects which measures any change in the outcome (annual probability of a birth) following the event (migration and residence in a new area), since the individual-level fixed effects controls for all stable differences across individuals. With this model, any changes in fertility should be attributable to the event of migration and subsequent residence in the (new) place of destination.

Table 9: Discrete time conditional logit model (probability of a birth in year *t*) with individual level fixed effects

Migrant Category	Odds Ratio	
Rural → Rural	1.615	***
Rural → Small urban	1.417	***
Rural → Large urban	1.124	
Small urban → Large urban	1.442	***
Small urban → Small urban	1.498	***
Large urban → Large urban	1.312	
Large urban → Small urban	1.463	**
Large urban → Rural	1.462	***
Small urban → Rural	1.542	***
Age	0.977	***
Married	17.567	
Parity *(reference: 0)*		
1	0.479	***
2 or greater	0.192	***

Source: Demographic and Health Surveys (1990-2008)
Model also controls for but does not calculate coefficients for the following constant (time-invariant) variables: age squared, education and household wealth
Odds ratios; * p<.05, ** p<.01, *** p<.001

Results from the discrete time conditional logit model with individual fixed effects (Table 9) suggest that the period following a residence is associated with significantly higher fertility for nearly all migrant categories. The only exceptions are for the two groups that had among lowest relative fertility as estimated in the logit models: rural-to-large urban migrants and large urban horizontal migrants, though neither are statistically significant. All other groups have odds of more than 40 percent of having a birth in a given year than they did in their place of origin prior to the move. These results suggest that migration and residence in new areas dramatically increases fertility for nearly all women.

This finding seems to run counter to what we would expect given the descriptive characteristics and models of cumulative fertility and appears to contradict the results from the logit models. However, I suspect that rather than controlling for unobserved differences across individuals, the fixed-effects models are reflecting the intersection of the age patterns of fertility and age patterns of migration. In this analysis, women who migrate do so on average more than year before mean age of childbearing, suggesting that most women have the majority of their children after migration, regardless of their overall level of fertility (Table 10). Furthermore, migrants appear to have their first births later compared to non-migrants from their place of origin and a lower mean age at birth. As a result, women with lower lifetime fertility but who have most or all of their children following their change of residence would appear to have higher fertility as a direct result of their move and of living in a new environment. I thus contend that here the discrete-time logit model is a more appropriate measure of the counter-factual for migrant fertility outcomes in the absence of a change in residence, and that the fixed-effects models are not appropriate for comparing fertility outcomes among migrants.

Table 10: Mean age at first birth, all births and migration for migrants and non-migrants

Migrant category	Mean age at first birth	Mean age at birth	Mean age at migration
All migrants combined	19.55	28.98	27.96
All non-migrants combined	18.88	32.31	--
Rural non-migrants	18.51	32.70	--
Small urban non-migrant	19.00	32.70	--
Large urban non-migrant	19.75	32.45	--
Rural → Rural	18.81	27.89	26.64
Rural → Small urban	19.45	29.06	27.43
Rural → Large urban	19.58	29.77	27.01
Small urban → Large urban	21.24	30.80	29.79
Small urban → Small urban	20.45	29.84	28.28
Large urban → Large urban	20.89	30.71	28.91
Large urban → Small urban	20.53	29.08	28.33
Large urban → Rural	19.46	28.29	25.96
Small urban → Rural	19.73	29.72	28.44

Though this analysis here does not delve into the various reasons behind residence change among women in SSA, it is worth commenting briefly on how different motivations for migration and relocation may work to influence fertility. For example, pursuing higher education or employment may drive urban-ward migration among many young women. Continued education and access to higher levels is a major determinant of migration in SSA, and students who are successful in school are more likely relocate to the larger cities where higher education institutions are concentrated. Rural to small urban migration tends may likewise coincide with success at primary school and relocating to attend high school, while a move from small-urban to large urban increases access to higher education. Marriage and family formation are likewise strong drivers of migration: relocating from urban to rural areas may be return migration driven by marriage or divorce while rural-to-rural migrations are more likely to be for nuptial purposes, not for education or work. These differences could explain differentials in annual birth probabilities between these two groups but research into the motivations and specific timings of residential relocation of women in SSA are better suited for future studies using detailed longitudinal data.

Conclusion

Results from this study suggest that internal migrants show changes in fertility outcomes after moving to new areas of residence. Findings here also indicate a small but discernable "urban effect" associated with internal migration and fertility outcomes for migrants moving to and from urban areas. ASFRs are generally lower among migrants and non-migrants, and are particularly low for migrants from small-to-large urban areas and higher among women who have relocated to rural areas. Analysis of children ever born likewise suggest that women who relocate to the largest cities (from rural areas and smaller cities) have lower fertility than do women who move to smaller cities (from rural areas or other small cities), suggesting that the influence of urban residence on fertility is strongest where fertility rates are lowest.

Regression results from the discrete time logit model of annual birth probabilities show that after 6 years only migrants moving to, from and within the largest urban areas have annual birth odds that are significantly lower than those for rural-to-rural migrants. The inclusion of individual-level fixed effects in the discrete time conditional logit model allows for a more direct measurement of the fertility of women who move before and after a change of residence, but results from this model indicate that nearly all migrant categories have higher fertility following residence in a new location. However, it appears that this fixed-effects model in fact reflecting the intersection of the age patterns of fertility and age patterns of migration , as most women who move do so before their peak age of childbearing, suggesting that individual-level fixed effects confound overall age patterns of fertility with individual increases in fertility. As a result, I argue that the discrete-time logit model is a superior approximation of the counter-factual for fertility outcomes in the absence of a change in residence, and I use the results from this model to argue that residence in new areas among all migrant groups moving to or from the largest cities shows apparent reductions in fertility attributable that could be attributed to the "urban effect." This, in turn, suggests that in West

Africa, high rates of internal migration may contribute positively to declines in fertility at the national levels.

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