THE EFFECTS OF EDUCATIONAL REVERSALS ON FIRST BIRTHS IN SUB-SAHARAN AFRICA: A DYNAMIC MULTILEVEL PERSPECTIVE[*]

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ABSTRACT

In many areas throughout sub-Saharan Africa, young adult cohorts are less educated than their predecessors because economic crisis brought on declines in school enrollments during the 1980s or 1990s. While low education would typically predict high fertility, a decline itself could theoretically have a counteracting effect if relative deprivation motivates lower fertility. We use Demographic and Health Survey data from 16 countries in sub-Saharan Africa in a multilevel fixed-effects model to assess the importance of educational reversals for first-birth timing. Our work indicates that a crisis that includes education decline is particularly unlikely to produce a delayed entry into parenthood.

(main text, excluding references, 6294 words)

The jury is still out regarding the relationship between economic crisis and fertility decline. Some have argued that economic crises have been an important trigger for fertility transitions (Basu 1986; Eloundou-Enyegue, Stokes, and Cornwall 2000; Guzmán 1994; Mbacke 1994; Rutenberg and Diamond 1993) or that they have promoted fertility reduction (Mari Bhat 1998; National Research Council 1993). Others have pointed to countries like Ghana that, despite having an established national family program, experienced severe economic hardship over an extended period without showing appreciable fertility change (Locoh 1994) or cases where crises like drought had a negligible effect on fertility (Caldwell, Reddy, and Caldwell 1988). It would be important to gain more knowledge about the effects of economic setbacks in poor countries. Many countries in sub-Saharan Africa have experienced a severely worsening economic climate over the last two decades, and similar contractions of the economy may be felt in the future also—in that region or elsewhere.

The economic crisis in sub-Saharan Africa has led to spending cuts and wage freezes in the public sector, in addition to reductions in individual incomes. One consequence is that progress in education has been retarded and even reversed (Colclough with Lewin 1993; Eloundou-Enyegue and DaVanzo 2003; Lloyd, Kaufman, and Hewett 2000). This phenomenon is quite unique historically. Most of what demographers know about the relationship between education and fertility has come from settings where average educational levels have improved monotonically.

At the individual level, higher education for women reduces fertility. Moreover, living in communities where the average education is relatively high may have an additional fertility-suppressing effect (Caldwell 1980; Kravdal 2002a). Therefore, one might expect that declining primary and secondary school enrollments would translate into higher fertility. However, the literature on which this argument is based has considered education effects in a rather static manner. Perhaps the birth rate is influenced not only by the current educational level, but also by whether there has been an increase or decrease recently (i.e., young women's education relative to that of women who are somewhat older)? If that is the case, and if this additional independent effect of a decline or a low "relative education" among the young is negative, which would accord with ideas about fertility impacts of relative income (e.g., Easterlin 1978), the total response to an educational reversal can run in either direction. Further, if a lower educational level in the community after all *does* contribute to a higher fertility, the response may be lagged

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if it is the educational attainment among men and women of mature age that is the key driving force, and not that among the youngest adults.

Our goal is to assess how educational declines in sub-Saharan Africa affect first births. The timing of initiation of childbearing is a strong determinant of cohort fertility, especially in societies where contraception is not widely adopted, and it also influences population growth rates and the well-being of the mother and child. Focusing on this part of the reproductive career has the advantage of avoiding selectivity problems that would make an analysis of higher-order births more cumbersome (further explained below). Besides, the first cohorts whose own attainments were affected by the educational reversals in the 1980s and 1990s were early in their childbearing years at interview, and therefore the effects of relatively low attainment on higher-order births would be harder to observe. We do not know whether this restriction will increase the likelihood of seeing effects of education reversals. The National Research Council's (1993) study, *Demographic Effects of Economic Reversals in Sub-Saharan Africa*, found more consistent effects of economic crisis on first- than second-order births, but other work has identified stronger effects of crisis at higher parity transitions (Eloundou-Enyegue et al. 2000).

EDUCATION IN DYNAMIC PERSPECTIVE

General Ideas About the Importance of Community Education

The woman's own education is generally accepted as a very important determinant of her fertility, and a large number of causal pathways have been suggested (e.g., Jejeebhoy 1995). It is less widely recognized that the education among other people in the society may also exert an influence on the woman's fertility. This "community education", shown by Kravdal (2002a) to have a strong effect in sub-Saharan Africa, may operate through several channels.

One of these channels involves social interaction (e.g., Bongaarts and Watkins 1996; Kohler, Behrman and Watkins 2001; Montgomery and Casterline 1996): a woman may, for example, learn about contraception from others, or there may be a transmission of preferences for spending time and money on children versus alternative sources of satisfaction. An individual woman may also imitate, or feel pressured to imitate, others' timing and quantum of childbearing, or various types of behavior that also have implications for childbearing, such as women's work outside the home and whether people send their children to school.[1] Of course, a woman does not interact directly with all others in a region, but she may interact with a sub-

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group that in turn interacts with others, and thus be part of a chain that includes the entire population in the region or a larger area.

Furthermore, there are more indirect mechanisms, because a high level of education among other people in the community may transform society in many ways. For example, if many other women are educated, attitudes toward women's work may have become more liberal, and jobs in the modern sector that are attractive to and suitable for women, and where they cannot bring their children with them, may have been created.[2] On the other hand, there is also a competition aspect: with a larger number of better-educated women to compete with, the chance of getting a high-status job is lower.

Community education may also operate on fertility through the general income level in the society in a direction that is no less ambiguous. Assuming that those who have some education are more productive and get higher wages, and that everyone benefits from that through multiplier effects, a higher level of education in the community may increase incomes and access to capital in all sectors. One effect of this is that agriculture may become more mechanized, thus reducing the need for child labor. Besides, demand for children may be influenced by the higher incomes among men. This so-called income effect is theoretically unpredictable, because child "quality" requirements may rise in step with the higher purchasing power. Another reason income effects are unpredictable is that economic hardship may make children less affordable, but may motivate women to create enduring ties with men by having their children (Guyer 1994).

In addition, the general income level in the community—some time back—is likely to be among the *determinants* of the educational level among young adults. This is discussed below.

All these factors are relevant both for first births, which are in focus of this study, and higher order births, although the former to a larger extent reflect timing decisions. Given that a stable sexual union has been formed, which itself may depend on some of the factors just mentioned,[3] the key issue typically is: do we want a child now or later? This gives a somewhat different twist to the economic arguments (see e.g., Happel, Hill, and Low 1984),[4] but opportunity and childbearing costs are still relevant to take into account. Obviously, arguments related to preferences and contraception are also directly relevant, and even more importantly, all factors bearing on quantum may be indirectly of importance for the timing, because those who plan to have relatively many children may need to start early.[5]

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The Importance of Community Education in Different Age Groups

The preceding discussion of community education gave little attention to the effects of educational attainment among various age groups in the population. There are two reasons why the effects of community education at different ages need to be considered: past educational attainment and current attainments may have different effects, and education decline (i.e., level among the young relative to that of the older) itself may matter.

Contraceptive knowledge already established among older women, partly as a result of their schooling, would still be available in their communities. Perhaps more saliently, discussion of family planning might be more normative in communities where education was more common in the past, and therefore knowledge could be conveyed more freely than if past attainments had not been high. Therefore, sustained enrollments might be unnecessary for providing new reproductive cohorts with contraceptive knowledge.[6]

The contribution of education to a broad transformation of society is also likely to be a long-term process. For example, the acceptability of high-status jobs for women may depend to a large extent on the educational level of older cohorts. Previous education also helps determine how many women are competing for whatever high-status jobs there are. Also wages in other sectors, both for men and women, will depend on the educational levels in broad age groups.

In addition to past education mattering in these ways, education trends may have independent effects. Declines in school enrollments could easily produce lower earnings. The trend in earnings among the relatively young may well be more important than the current level itself, because the material aspirations among the currently young may have been determined to a large extent by the economic strength they have seen among those who are somewhat older, or among their own parents. This would accord with the classic idea that relative income has a strong bearing on fertility (e.g., Easterlin 1978). In other words, fertility may be influenced by the income (potential) among the young compared to those who are somewhat older, which in turn is influenced by the trend in education (relative education).

Alternatively, a decline in education itself may *increase* fertility. First, while relatively low wages for men seem quite likely to reduce fertility, the effect of low income or wage potential for women compared to that in the past is harder to predict. If hardship were construed as a temporary state, women might take advantage of a time when the opportunity costs of childbearing were relatively low and thus accelerate their childbearing, hoping to pursue other

options later.[7] Second, people may be discouraged about the value of education (see e.g., Osei-Agyemang 1996; Raikes and Gibbon 1996), and therefore be less interested in sending their children to school and face lower costs associated with a first child. Spelling this out in more detail, the intention to send a child to school is likely dependent on norms about schooling, parent's income when the child is of school age, the alternative uses of the child's time in remunerable work, school fees, and expected returns to education. Surely, much of this depends on individual and community characteristics some years after a fertility decision is taken, but perceptions about such matters may hinge on the educational attainment both among the older and younger, as well as the difference between them. In particular, people may have doubts about the returns to education if they have seen relatively high investments in education earlier, accompanied by income drops (resulting from or causing education declines).

CHANGES LINKED WITH EDUCATION DECLINE

In the foregoing section, we pointed out how decline in education might lead to relative deprivation, with further effects on fertility. However, a reduction of the average educational level among the young adults in focus on this investigation is surely also a *consequence* of declining incomes—among their parents and in the country as a whole.[8] School fees were imposed or increased as a result of national fiscal austerity and structural adjustment programs, and many families could not pay or keep their children out of work. Would-be parents who have seen increasing school fees in their generation may expect them to remain high,[9] and thus choose to enter into childbearing later after they have more resources to meet the fees, or to give up educational aspirations for their children.[10]

Another consequence of stagnant or deteriorating economies is that the *quality* of the teaching has deteriorated (Goody 1993; Raikes and Gibbon 1996). Young women at a given level of education may have become less well equipped to participate in the modern economy, with a relatively high fertility being the most likely result. Furthermore, education declines have sometimes been accompanied by sharp cuts in public health care, with implications for child mortality and mothers' health, as well as in family planning programs[11] (Macassa et al. 2003; Mason 1993). Although there may be mixed effects of this, it is perhaps, on the whole, most reasonable to expect a stimulation of the birth rate.

Finally, the above arguments for why the general level of income in a society may operate on birth rates pertain whether lower incomes result from lower education or cause lower education.

In sum, when we measure education decline, we capture a feature of contemporary African economies that could have independent effects on fertility. In particular, education decline does not emerge independently of other hardships. As explained below, the inclusion of fixed effects for regions helps us get rid of some of the factors that may create a spurious relationship between (relative) education and fertility, but is only a partial solution.

OPERATIONALIZATION

The foregoing discussion elucidated some reasons why fertility could be influenced by education in various age groups, as well as the differences (trends). This issue was ignored in the study by Kravdal (2002a), where community education was defined as the average among all women of age 15-49. If only such an average over a broad age groups is assumed to be important, and it has a negative effect, the implication is that a country with a stable high education will have low fertility and that a country with a stable low education will have high fertility (all else equal), while the change for a country that passes from high to low education is the same as the difference between the country with stable high education and that with stable low education. Other patterns will not be consistent with such a model. On the other hand, if it is assumed that the difference itself has a negative effect, a country that passes from high to low education may, at least temporarily, attain a fertility that is lower than that of the country with stable high education. Obviously, it would be best to estimate a model that is flexible enough to allow also this pattern.

In this paper we take only one simple step in the direction of a more dynamic approach, by considering two age groups. We select the age group typically under exposure for first births in this setting, 15-24, and those 10 years older, 25-34.[12] Let us denote the two corresponding community education averages A and B, and their difference $C=B-A$. Of course, all three variables cannot be included in the same model. We have chosen B and C, older women's education and the difference, which provides us with conveniently interpretable estimates.[13]

Let us elaborate on this model. Assume first that the community-level contribution to the first-birth rate is given by $F = aA + bB + cC$. This can be re-formulated as $F = (a+b)B + (c-a)C$.[14] Assume also that the average educational level among 15-year olds is stable for a long period,

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then drops linearly for 20 years, and subsequently stabilizes at a lower level. Thus, the average among those aged 15-24 will fall at the same time, but not so sharply in the beginning, and the leveling off will also be less sharp (curve 1, Figure 1). The same trend, except for a delay, will be seen among those who are 25-34.

(Figure 1 about here)

Let us further assume that the effect of B in our model (i.e., coefficient a+b) is negative. The fertility trajectory shown in curve 2 is that which would take place if only average community education of all women aged 15-34 is relevant: $F=(a+b)H$, where H is the average of A and B. In this case, c-a is positive and equal to minus the average of a and b. This is the only movement that can be captured in a simple model such as that estimated by Kravdal (2002a). If c-a is still positive, but as large as minus the sum of a and b (rather than their average) F is given by $F=(a+b)B -(a+b)C=(a+b)A$, which means that fertility increases more rapidly because it depends only on the attainment of 15-24 year-olds, a factor that changes faster with education decline than the attainment of 15-34 year-olds (curve 3).

The scenarios outlined in the bottom two curves are consistent with the notion that low relative education motivates lower fertility (c is negative, which it also can be, but not necessarily, in curve 2). In curve 4, the trend coefficient (c-a) is 0, meaning that the fertility-suppressing effect of education decline itself exactly offsets the fertility-enhancing effect of lower education levels among young adults. Thus, the movement in fertility follows the education of the older women and is delayed compare to the other curves. In contrast, curve 5 outlines the scenario where the effect of decline itself is *greater* than the fertility-enhancing effect of lower education (c-a<0); in this case, fertility decreases initially. As C stabilizes and B falls, F increases.

Put differently, if fertility decline is to be caused by a crisis marked by educational reversals, according to a simple model such as specified above, the trend coefficient, c-a, needs to be negative. In real life, there are many more factors operating on fertility than those included in our model. A self-enforcement of low fertility, as indicated by historical studies from (prosperity-led) fertility transitions, can be among these. If fertility drops as a result of a dominant negative effect of relative education, as depicted in curve 5, it is possible that this lower fertility level contributes to further reduction in fertility, and that this even outweighs the upward contribution shown in the last part of curve 5. It should be noted, however, that such a

mechanism cannot produce any permanently lower fertility unless there is a drop in the first place, which can only occur as a result of educational changes if a low relative education is strongly associated with reduced fertility. We estimate effects such as a+b and c-a to see what type of total response there is to an education decline, taking also individual education (*E*) into account.

DATA AND METHODS

Survey data

Various community factors that are not observed may determine both the level of education and the birth rates. One way to account for at least the time-invariant unobserved factors is to use data that include two or more measurements for each community and enter community fixed-effects into the models (see elaboration below). Unfortunately, few countries in sub-Saharan Africa have had two or three waves of DHS surveys in the same primary sampling units (i.e., the village level). With region or province as the level of aggregation, however, more countries can be included in the analysis. Assuming that the distinction between urban and rural has remained fixed or changed little in the relatively short time between surveys, the level of aggregation in this analysis is further reduced to the rural and urban areas (a few are only urban) within provinces (for simplicity referred to as regions below). It should make good sense theoretically to consider wider communities than the sampling clusters represent, and these larger geographic units also provide a more satisfactory sample size for estimation of education averages and changes.

We used data from the 16 sub-Saharan African countries that had more than one Demographic and Health Survey after 1990: these are listed in the appendix. We did not use surveys from before 1990 because the timing of educational reversals makes the more recent period more suitable for assessing fertility effects. We also omitted Côte d'Ivoire and Namibia because although each had more than one DHS after 1990, the regions identified were not compatible between the two surveys. Leaving out the first or intermediate survey for the countries having three surveys gave very similar results to what we present below.

The surveys used a clustered sample. A number of regions were defined for each country, and within these regions, some small census enumeration areas were selected. These were assumed to be representative of the respective regions or their rural or urban parts.[15] Within each such census enumeration area, typically spanning one or a few villages, a small town or part of a

larger town or city, about 25 households were randomly selected, and all women of reproductive age in the household interviewed. In some of the countries (i.e., Tanzania, Nigeria, Kenya), 25 or more administrative regions were defined in the survey, but we used the larger (geopolitical) regions to make the number of respondents per region more in line with that in other countries. The number of regions used in the analysis is 193 (see appendix).

Statistical Model

We modeled only the determinants of first births. This is practically convenient, because extending the focus to higher-order births would have required a simultaneous modeling of all parity transitions, which also calls for a long follow-up period. Education effects may be seriously biased in models estimated separately for, say, second or third births (Kravdal 2001).

We estimated discrete-time hazard models for first births during the two years before the surveys. Across the 16 countries and two-three points in time, there are about 290,000 woman-years of exposure to risk of first birth in the two years prior to survey, and 17,000 first births. In principle, the woman in focus may not have lived in the region during the whole follow-up period, and even if she did, the average education in the beginning may be different from that at the time of interview, because of other women's migration. Furthermore, the socioeconomic characteristics of an individual woman may change over time. During the first part of the follow-up period, the woman in focus may actually have had another educational level and another score on other resource variables than reported at interview, and this translates into a similar problem at the aggregate level, of course. There is information in the DHS surveys about the number of years a woman has lived in the census enumeration area, but we do not know whether the in-migrants have come from another area in the same region, and we do not know anything about those who have left the area. However, these problems are probably rather small when the follow-up period is as short as two years, although there is a causality problem involved with the (individual) education variable that will be discussed below. It should be noted that very similar results appeared when the period was extended to three or four years or shortened to one year. Each woman contributed a series of 6-month observation intervals, which was shown to be sufficiently short. (The same results were achieved with three-month intervals.) The women were followed from two years before the survey unless they were younger than 15 at that time, in which case they were followed from age 15. The follow-up period ended at first birth, the time of

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interview, or at age 24, when the large majority had become mothers. The cut-off at age 24 was shown not to be critical.

The statistical model is

$$\log(P_{ijt}/(1-P_{ijt})) = a_0 + a_1 E_{ijt} + a_2 B_{jt} + a_3 C_{jt} + a_4 X_{ijt} + f_j \tag{1}$$

where P_{ijt} is the probability that a childless woman i in region j at time t has a child within the observation interval of six months, and E_{ijt} is her educational level, measured at the first following interview. B_{jt} is a vector of variables describing the level of education among women aged 25-34 in the region, while C_{jt} is a vector of variables describing the difference in education between those of age 25-34 and those of age 15-24. *B* and *C* are also measured at the time of the first following interview and are defined in detail below. X_{ijt} are other individual or regional characteristics, further described below, and f_j are regional fixed-effects (0/1 dummies for each region except one that is arbitrarily chosen as a reference region). With these fixed- effects included, X_{ijt} cannot, of course, include regional variables that are constant over time.

All estimation was done with the Logistic procedure in SAS. At the introductory stage, we also estimated models in STATA, using the Huber correction for heteroskedasticity, but this gave very similar results.

Individual Education

Individual education is grouped into 0-2, 3-6, 7-8, 9-10, and 11 or more years. Ideally, one should have information about the level at any time in the follow-up period, which may influence the birth rate at that time, along with the enrollment and the educational goals. This level may be different from that at interview, and most importantly, the difference may, in principle, partly be a *result of* childbearing.[16] This causality problem is most pronounced for the highest categories of the education variable, because those who complete primary education have usually done so before age 15.[17] Given the problem associated with the highest educational categories, one might have pooled all these together with the completed primary education. In that case, however, the community education variable would have picked up the effect of individual secondary education.

Community Education

We make a distinction between community primary and secondary education in some models, while they are combined in others. $B^{(1)}_{jt}$ is the average number of years of primary education for women aged 25-34 at interview (i.e., all schooling beyond seven years is ignored), while $C^{(1)}_{jt}$ is

the average number of years of primary education for women aged 25-34 minus the corresponding average for those aged 15-24. $\mathbf{B^{(2)}_{jt}}$ is the average secondary education (i.e., seven years of education has been subtracted) that the age group 25-34 had when they were 15-24. This subtraction of education during the last ten years before survey is done by assuming a continuous education from age seven. For example, a woman who reports 12 years of education at age 26 is assumed to have taken nine of them (seven primary and two secondary) before she was 16 and the remaining three afterwards. $\mathbf{C^{(2)}_{jt}}$ is the difference between $\mathbf{B^{(2)}_{jt}}$ and the average secondary education among those aged 15-24. Defined in this way, $\mathbf{C^{(2)}_{jt}}$ is a reasonable indicator of the trend and the young women's position relative to the older.[18] The remaining secondary education at age 25-34 (i.e., taken the last 10 years) is $\mathbf{B^{(3)}_{jt}}$.[19]

Other Independent Variables

Age was included as a six-level categorical variable, which was shown to be a sufficiently fine specification.[20] Period was also included as a control. Generally, period is important for the estimation of community education effects in countries where, for example, education increases while fertility declines for other reasons. (In the absence of a period variable, a relatively low fertility in observations with high community education would partly reflect that these observations tend to be from the most recent survey when fertility would be lower anyway.) The calendar year of exposure was included as a continuous variable. Model experimentation showed that categorization gave similar effects of education. Because trends are known to differ across countries, interactions between year and country were included. Without these interactions, the effect of current community education would have been somewhat weaker and that of the change somewhat stronger. Interactions between age and country were not important to include.

Community wealth and "modernization" may be determinants of community education, or result from the same development trends that promote education. Three indicators of these factors were therefore included: proportion of husbands in agriculture, wealth index (based on ownership of some consumer items), and proportion of households with electricity. However, because the causality may also run in the opposite direction, we show models both with and without these variables. As expected, there has, on the whole, been an expansion of electricity, an increase in wealth, and a decline in agriculture between the two last surveys, but the modernization, as measured with these variables, has been most pronounced in areas where the educational level among the young adults has increased the most.

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Wealth and electricity are included also as individual-level variables, because, although they are measured at interview, they may reflect the economic resources in the woman's family of origin and thus be among the determinants of her education. Religion was included at the individual level, but not at the community level, where change over the few years between the surveys is not probable. Women's autonomy is likely to be associated with women's education, but explicit indicators, such as participation in decision-making, were only available in some of the surveys.

Fixed-Effects: Benefits and Limitations

The fixed-effects pick up characteristics of the communities that are constant over time, such as whether they are urban or rural, the distance from the capital, topography, climate, and basic economic and institutional structures linked to the availability of natural resources. Some of these factors could alternatively have been captured by variables in the survey, but not all. Such a control is obviously important. For example, we would not be interested in sharply negative effects of education merely reflecting that areas with a high educational level are generally more "modernized" (beyond what is measured in the available data), which also drives fertility down for other reasons.

With fixed-effects included, the estimated effect of, for example, the current level of community education (*B*), reflects whether the difference in the birth rate between a person in a certain area in the second survey and that of a similar person in that area in the first survey varies systematically with the difference in community education between these two surveys. However, if such a relationship is seen, it might also be a result of time-*varying* unobserved community characteristics influencing both education and fertility. Examples might be changes in the income level (due to external factors that add to the constant, basic factors mentioned above) or a worsening AIDS epidemic (operating in part through parental hardship and teacher mortality; see Grant and Palmiere 2003). Similarly, fertility differences between the surveys that might appear to be related to changes in the education trend might instead arise from policy or economic changes.

Furthermore, these community factors that we do not capture can be linked with individual factors that are not measured. For example, in addition to being surrounded by relatively rich neighbors or benefit from good health centers developed because of a good economy, the women who live in areas with a high community education may also be rich

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themselves, beyond what is measured by the included variables. A particular reason why the persons themselves may be different with respect to the unobserved factors is selective migrations. The woman who lives in an area where community education is high, may for example, have moved there or remained there because she has special talents that she hopes to better exploit in such a society.

These problems are very hard to solve, even with richer data on migration (for further discussion of how difficult it is to identify community effects, see for example Diez Roux 2004; Macintyre, Ellaway, and Cummins 2002; Manski 1993; Oakes 2004). We can only include as many relevant control variables as possible, along with the fixed-effects, and recognize when interpreting the estimates that, for example, the educational change variable may pick up various components of the economic crisis that are linked with it.

RESULTS

Educational Levels and Trends

Table 1 shows the average level of primary education at age 25-34 in each of the 16 countries according to the most recent survey. The variation is large. For example, the country average is 0.69 in Burkina Faso (varying from 0.14 to 4.06 across regions; not shown), while it is 6.34 in Zimbabwe (varying from 5.08 to 7.00; not shown).

(Table 1 about here)

We believe that despite a great deal of attention to gender equity in education and the harmful effects of user fees on enrollments, the social reality of education decline has been under-appreciated: almost a quarter of the communities have cohorts of young women who are less educated than their predecessors. A decline in education between age 25-34 and 15-24 is seen in 43 of the 193 regions. In Madagascar, Rwanda, and Tanzania, a decline in education appears for at least half of the regions. Also Zambia has a large proportion of regions with a decline.

The difference between the age groups 15-24 and 25-34 reflects trends in enrollment during the 1980s (20 years is the average age of the first age group, and they were 10 years old in 1989, as an average across the surveys). We also show in Table 1 the proportion of regions in which the coefficient was positive (i.e., decline in education) when education was regressed on age over the interval 15-24 years. This provides an illustration of the more recent trends than that reflected in the other measure (on average the difference between age 20 and 30). Four more

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countries show considerable decline when this indicator is used: Kenya, Niger, Nigeria and Zimbabwe.

Multivariate Fixed-Effects Models

A high average number of years of primary education among women who are 25-34 pushes the first-birth rate down (Table 2, Panel A). It is important to see this effect confirmed in an analysis that, in contrast to the previous analysis of community education effects on fertility in Africa (Kravdal 2002a), includes community fixed-effects. Effects of primary education are particularly interesting, both at the individual and community level, because they are not hampered by a possibly reverse causation.

Secondary education has no significant effect when the part (about 0.2 years) that is taken during the last ten years is ignored. However, that part is negatively related to fertility, and when it is added, secondary education (now $B^{(2)}+B^{(3)}$) has a significant negative effect on the first-birth rate (not shown in the table).

More interestingly, the difference in education between the two age groups does not have a significant negative effect, which would be needed to produce an initial negative fertility response to education decline. This is true both for primary and secondary education.[21]

In panel B, primary and secondary education are, for simplicity, pooled together, and the amount of education taken during the ten years before interview among those aged 25-34 is ignored (i.e., the level variable is $B^{(1)}+B^{(2)}$ and the difference variable is $C^{(1)}+C^{(2)}$). The point estimate of the effect of the difference is positive, and has about a third of the size of the effect of the level. This corresponds to a response that is only a little more delayed than it would be according to a model including only the average education among the broader age group 15-34. In other words, the community-level contribution would lie between curves 2 and 4 on Figure 1. The negative effect of individual education adds, of course, to the positive fertility response.[22]

Including wealth and modernization indicators has little impact on the effects of community education. However, the effect of individual education becomes somewhat weaker when these variables and religion are taken into account.[23]

SUMMARY AND CONCLUSION

There have been mixed views about the fertility impact of economic crisis. Economic hardship has a variety of consequences, whose effects on reproductive behavior may indeed be very

different. In this paper, the focus is on the impact of educational reversals in sub-Saharan Africa over the last couple of decades, which are linked with severe constraints in the economy.

At the outset, one might believe that effects of declining education are easy to predict. Educated women have repeatedly been found to have low fertility, and also community education has been shown to be negatively associated with a woman's birth rate, although this had not previously been verified with fixed-effects models. The implication of these patterns would be that fertility would increase in response to a decline in education.

However, previous studies have not taken a sufficiently dynamic perspective. It is theoretically plausible that there may be an additional effect of a decline (or increase) in education, net of the current level of community and individual education. In particular, we have suggested that, in addition to being *driven* by economic factors, the level of education in the community will *feed back* on the economy, so that educational reversals may operate on fertility through relative deprivation. If this effect more than outweighs the effect of reaching a lower educational level, a lower fertility may result.

Such effects are not seen, however. While the effect of the current level of community education is significantly negative in these models, the trend did not have a significant impact on the first-birth rate. In fact, the estimates show that a simpler model that includes only the average over a broader age group performs well enough.

A relatively unhealthy trend in education is to a large extent a result of a particularly poor development of the general economy in that area some time in the past, resulting in many different kinds of hardship that may bear on fertility. Some of this is likely to be picked up by the educational trend variable. However, there may well be considerable economic hardship also in areas that have not experienced a stagnation or reversal of the educational levels. Indeed, many countries in Africa have suffered economically without having seen setbacks in school enrollment. Therefore, our findings shed some doubt on the idea of crisis-led fertility decline, but we have surely not provided a sufficient basis for excluding the possibility that the total effect of an economic crisis may be to push first-birth rates down. Nonetheless, educational reversals—which may mark particularly deep crises—apparently do not add to any such fertility-reducing effect. On the contrary, the opposite is more plausible in view of our results. When a crisis includes education decline, a drop in fertility seems particularly unlikely.

NOTES

[1] Community education is, of course, not the only structural factor of importance for children's enrollment rate (see below). However, regardless of the underlying forces, a key issue from the perspective of this study is that a woman who sees that many children are enrolled in school may be particularly keen to send her own children to school, which would increase her costs of childbearing (see also Axinn and Barber 2001).

[2] Even in poor settings where childcare may be quite easily available, women's modern sector work is associated with lower fertility (DeRose 2002; Hass 1972; Kritz and Makinwa-Adebusoye 1993; Peek 1975).

[3] High individual income and education are usually found to increase the rate of marriage for men, while results are more diverse for women, reflecting not least that both specialization and pooling of resources may be important gains from marriage (e.g., Oppenheimer 1994). In addition, the impact of community education and income is likely to involve a competition aspect.

[4] Two economic reasons to postpone childbearing may be that (i) lifetime costs would be lower if the birth is put off for some time (for example because the woman is currently enrolled in school and may be unable to fulfil her educational goals if she has a child soon), or (ii) that a higher family income is expected in the future, which would make it easier to cover the short-term childbearing costs. The higher these costs, and the lower the purchasing power at the outset, the stronger the incentive to postpone.

[5] For example, the effect of seeing other children in school may be less pronounced for first births. While those who plan to send their own children to school would face higher costs than others, this additional cost is incurred six years after birth and onwards. Delaying that cost a few years would probably not count much in the decision-making. However, the proportion of children in school may operate through the quantum desires.

[6] Montgomery and Casterline (1996) have noted, however, that "There is a developmental dimension to knowledge and attitudes about reproduction, with each new cohort having to clarify for itself matters that are already appreciated by adults."

[7] In accordance with that, some studies have shown that unemployment for women has little effect on fertility in rich welfare states, while that of men reduces it markedly (e.g., Kravdal 2002b).

[8] Duryea, Lam, and Levison (2003) show strong effects of unemployment of the household head on drop-out probabilities. Household income level also affects whether children can be kept in school during periods of economic crisis (Frankenberg and Suriastini 1999). In sub-Saharan Africa, the institution of child fosterage gives children the opportunity to attend school even if their own parents do not live in a community with a school, but families under economic strain are less willing to foster children in (Eloundou-Enyegue and Stokes 1999; Makinwa-Adebusoye 1994).

[9] Contemporary evidence supports this notion in that parents in areas where cost-recovery measures have been implemented under structural adjustment do not believe that primary education is free even when it is (Brydon and Legge 1996).

[10] Oliver (1995) found that the net effect of higher fees is to increase fertility.

[11] Richey (2004) contends that family planning programs are better-preserved with spending cut-backs than are other maternal and child health interventions.

[12] Other age intervals, reflecting trends over other years, might have been selected. As a sensitivity check, we regressed the average level of primary education over age within different age intervals, and included the regression coefficient in the model instead of *C*. We chose the interval 20-29 (whose end-points are also the mid-points of the age groups 15-24 and 25-34 used above), the younger intervals 15-24 and 15-20 that would reflect more recent trends, the even younger interval 10-14 (using data from the household file and ignoring schooling beyond 2 years), and finally the interval 30-39. None of these alternatives produced different results from those shown below. We also checked whether longer time between surveys would matter, by focusing on the interval seven to five years before the first surveys rather than the last two years, and backdating age and individual- and community-level education correspondingly (which raises some problems, though). Again, the estimates yielded the same conclusions.

[13] The estimation could have been difficult if the two were strongly correlated, but that was not the case.

[14] The alternatives are: $F = (a+b)A + (b+c)C$, $F = (a-c)A + (b+c)B$, or $F = (a+b)H + (c+b/2-a/2)C$ where H is the average $(A+B)/2$.

[15] Thus, weights were not necessary when constructing averages at this level.

[16] For example, a low first-birth rate at age 17-19 for a woman who has 11 years of schooling at age 19 may reflect also that the fact she did not want to have a child that might have made it difficult for her to continue the education – and that she succeeded in avoiding that. Conversely, the higher rate among those with only primary education may be partly explained by the fact that those who had a child in secondary school were expelled.

[17] Assuming a continuous schooling from age seven, one can impute current educational level and enrolment for years before interview, although this does not really solve the causality problem. We estimated such a model, but very similar effects of education appeared.

[18] For example, the youngest are not likely to feel that they are in an inferior position if the older cohort has more education only because they have a higher age and thus have had more years to take some secondary education.

[19] There is, in principle, a causality problem with the community variable also, but only at the secondary level. The average number of years of secondary education in a community may be high because the average age at first birth is high. This can obviously be linked with the individual woman's birth rate.

[20] Generally, interactions with age are potentially important in first-birth models. For example, certain characteristics may be associated with late entry into motherhood, but not a higher chance of remaining childless (i.e., low rates at low ages, to be compensated by higher rates at higher ages), or vice versa. Our approach to this problem was to check whether effects were markedly different when the age interval under analysis was restricted to 15-19 years. It turned out that the effects of individual education were more sharply negative at these lower ages, while community education effects were very similar to those at the higher ages.

[21] Taking instead the difference between the entire secondary education at age 25-34 and that at age 15-24, i.e., $B^{(2)}+B^{(3)}-A^{(2)}$, did not produce a significant effect either; not shown in the table.

[22] We have also included a categorized variable for the difference between the age groups (not shown in the table), because, in principle, the weak effect might conceal a negative effect of decline and a lack of positive effect of increase. However, such a non-linearity could not be seen.

[23] We also estimated models with interactions. Some authors have used diminishing or reversed socioeconomic differentials in fertility as a criteria for defining fertility transitions as crisis led (e.g., Basu 1986; Cleland 1993; Martine 1996; see also DeRose, Dodoo, and Patil 2002). However, the interaction between E and C (small point estimate and p-value of about 0.10) gave little support for the idea that educational fertility differentials would be diminished or reversed in areas with educational reversal. The point estimate did indicate that effects of education decline would be positive at each level of the woman's own education. In addition, the effects of individual-level education were sharper the higher the level of education in the community (significant negative interaction between *E* and *B*), but the differences were small (just as in Kravdal 2002a; see also discussion in Jejeebhoy 1995). Finally, education decline might be more problematic if the starting level is low, so that the *relative* decline is very large. In support of that, we found a significant positive interaction between the *B* and *C*. For example, if the community average at age 25-34 is one year, a one-year decline will reduce the community-level contribution to the logit of the birth probability by 0.047 (i.e., the effect is -0.047). The effect at 3 years is 0.007, and that at 5 years is 0.061. However, this negative estimate for the areas that have a low level of education at the outset is not significant (and it is not significant in a model estimated separately for these areas either). Besides, the total effect of declines in education from low levels would be positive anyway, because of the individual-level contribution.

Appendix: Regions in the Sample (U means only urban)

Benin (1996 and 2001): Atacora, Atlantique, Borgou, Mono, Oueme, Zou (6)
Burkina Faso (1992 and 1999): Ouagadougou (U), North, East, West, Central/South (5)
Cameroon (1991 and 1998): Yaound/Douala (U), Adam/Nord/Ext-Nord, Cntre/Sud/Est, Ouest/Littoral, Nord-Ouest/Sud st (5)
Ghana (1993 and 1998): Western, Central, Greater Accra, Volta, Eastern, Ashanti, Brong Ahafo, Northern, Upper West, Upper East (10)
Kenya (1993 and 1998): Nairobi (U), Central, Coast, Eastern, Nyanza, Rift Valley, Western: (7)
Madagascar (1992 and 1997): Antananarivo, Fianarantsoa, Toamasina, Mahajanga, Toliary, Antsiranana (6)
Malawi (1992 and 2000): North, Central, South (3)
Mali (1996 and 2001): Kayes, Koulikoro, Sikasso, S'gou, Mopti, Timbuktu (U in oldest survey), Gao (U in oldest survey), Bamako (U) (8: Kidal omitted because surveyed only in 2001)
Niger (1992 and 1998): Niamey (U), Dosso, Maradi, Tahoua/Agadez, Tillaberi, Zinda/Diffa (6)
Nigeria (1990, 1999 and 2001): North Central, North East, North West, South East, South South, South West (6: Kano omitted because of boundary problems)
Rwanda (1992 and 2000): Kigali, Northwest, Southwest, Central/South, Northeast (5)
Senegal (1992 and 1997): West, Central, South, North East (4)
Tanzania (1992, 1996 and 1999): Coast, North Highland, Lake, Central, Southern Highland, South, Zanzibar (7)
Uganda (1995 and 2000): Central, Eastern, Northern, Western (4)
Zambia (1992, 1996 and 2001): Central, Copperbelt, Eastern, Luapula, Lusaka, Northern, North-Western, Southern, Western (9)
Zimbabwe (1994 and 1998): Manicaland, Mashonaland C, Mashonaland E, Mashonaland W, Matabeleland N, Matabeleland S, Midlands, Masvingo, Harare and Chtungwiza (U), Bulawayo (U) (10)

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Table 1. Measures of Community Education Ignoring Years Above 7, According to the Most Recent Survey

Country	Education at 25-34 Average	Education at 25-34 minus education at 15-24 Average	Education at 25-34 minus education at 15-24 Proportion of regions with decrease	Proportion of regions with decrease according to regression over age 15-24
Benin	1.71	-0.39	1/12	1/12
Burkina Faso	0.69	-0.37	0/9	2/9
Cameroon	4.23	-0.52	0/9	3/9
Ghana	4.20	-0.87	1/20	3/20
Kenya	6.01	-0.21	5/13	**11/13**
Madagascar	3.72	**0.43**	**10/12**	**11/12**
Malawi	3.20	-1.13	0/6	1/6
Mali	1.03	-0.17	2/13	2/13
Niger	0.88	-0.22	2/11	**6/11**
Nigeria	4.00	-0.48	0/12	**9/12**
Rwanda	3.89	**0.04**	**5/10**	**10/10**
Senegal	1.91	-0.53	0/8	1/8
Tanzania	5.31	**0.29**	**8/14**	**9/14**
Uganda	3.75	-0.73	0/8	2/8
Zambia	5.12	**-0.02**	**7/18**	**11/18**
Zimbabwe	6.34	-0.26	2/18	**7/18**

Note: Averages in bold where approximately 0 or higher; proportions in bold where > 1/3

Table 2. Effects on First-Birth Rates of Individual and Community Education in 16 Sub-Saharan African Countries

Panel A	Logit coefficients
Individual education	
0-2	0
3-6	-0.189*** (0.024)
7-8	-0.430*** (0.030)
9-10	-0.884*** (0.038)
11-	-1.419*** (0.040)
Average number of years of primary education at age 25-34 ($B^{(1)}$)	-0.139** (0.052)
Average number of years of secondary education at age 25-34, ignoring that taken the 10 years before interview ($B^{(2)}$)	-0.072 (0.114)
Difference in number of years of primary education between age 15-24 and 25-34 ($C^{(1)}$)	0.040 (0.051)
Difference in number of years of secondary education between age 15-24 and 25-34, ignoring that taken the 10 years before interview for the latter age group ($C^{(2)}$)	-0.015 (0.098)
Average number of years of secondary education at age 25-34, taken the 10 years before interview ($B^{(3)}$)	-0.319** (0.158)

Note: Also included in the models: age (seven categories), year, and interaction between country and year.

*p$\leq$ 0.05; **p$\leq$ 0.01

Panel B	Model 1	Model 2
Individual education		
0-2	0	0
3-6	-0.166*** (0.024)	-0.128*** (0.028)
7-8	-0.395*** (0.028)	-0.326*** (0.029)
9-10	-0.826*** (0.037)	-0.720*** (0.037)
11-	-1.339*** (0.039)	-1.189*** (0.040)
Average education 25-34 ($B^{(1)}+ B^{(2)}$)	-0.163*** (0.034)	-0.137*** (0.040)
Difference between education at 25-34 and 15-24 ($C^{(1)}+ C^{(2)}$)	0.050 (0.036)	0.038 (0.038)
Other individual variables		
Muslim		0.235*** (0.031)
Christian		0
Traditional religion		0.207*** (0.056)
No or other religion		0.187*** (0.045)
Household wealth index		-0.037** (0.012)
Whether household has electricity		-0.336*** (0.030)
Other community variables		
Average household wealth index		-0.008 (0.126)
Proportion of households with electricity		-0.140 (0.267)
Proportion of husbands working in agriculture		-0.168 (0.237)

Note: Also included in the models: age (seven categories), year, and interaction between country and year.

*$p\leq 0.05$; **$p\leq 0.01$

A Sketch of the Decline in Community Education and Its Possible
Contribution to First Birth Rates, according to Different Models

Contribution to first-birth rate (marked curves)

Community education (years)

Time

curve 1: Educational level at age 15-2
curve 2: c-a=0.5(a+b)
curve 3: c-a=-(a+b)
curve 4: c-a=0
curve 5: c-a < 0